5 Windows Killers! rebel operating systems

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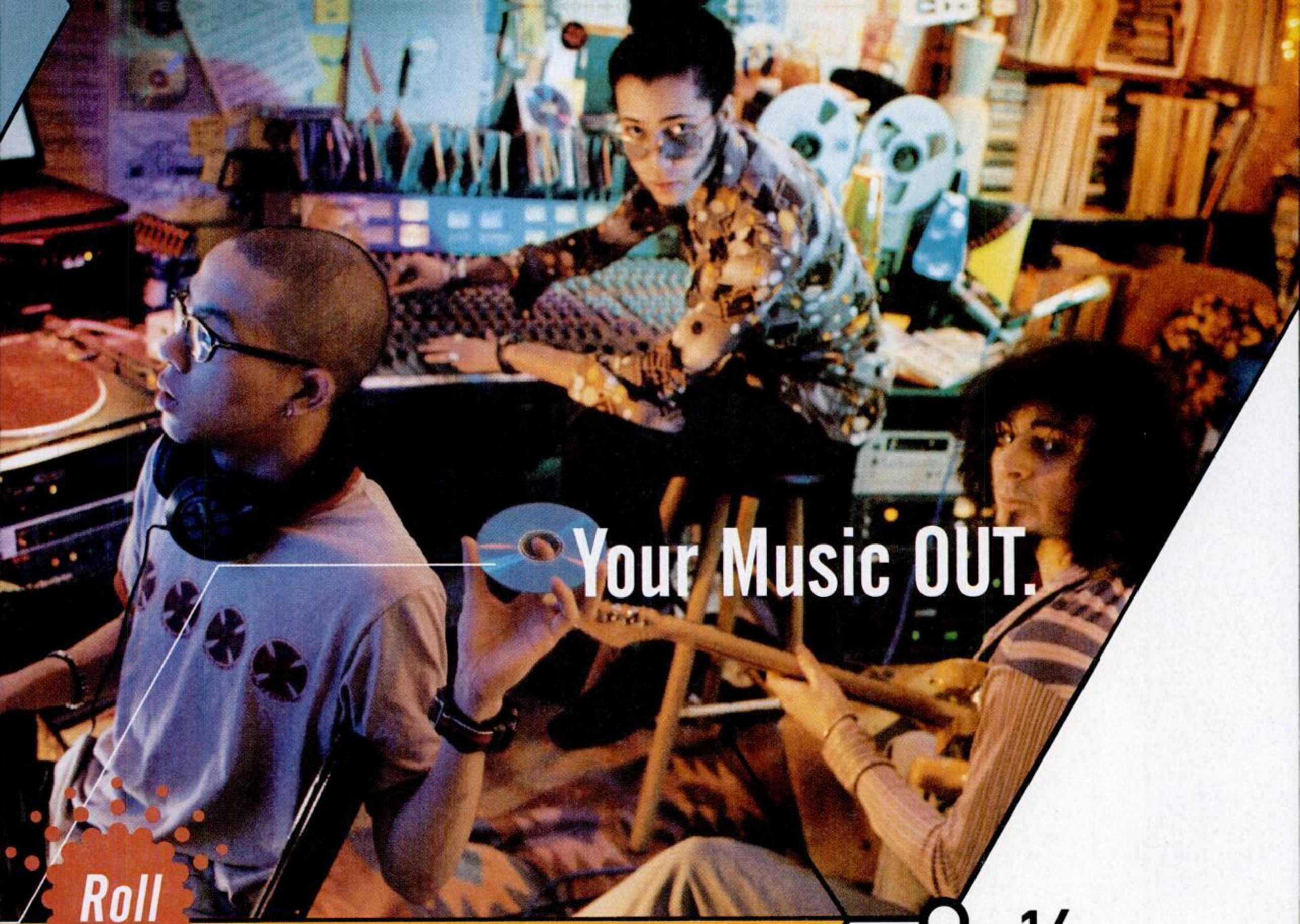

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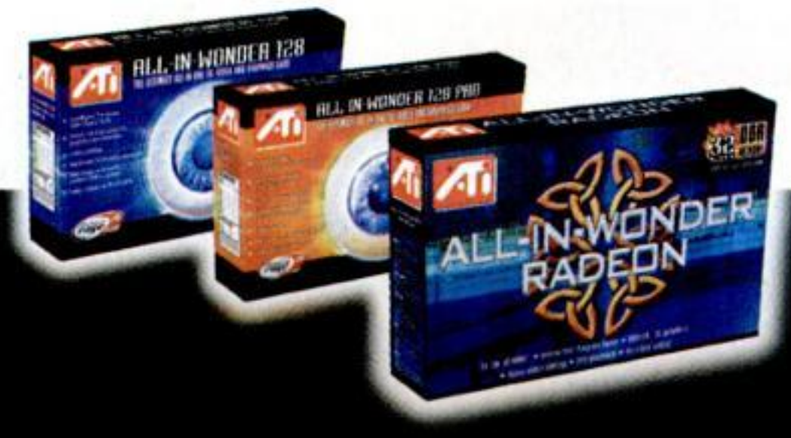

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MARCH 2001

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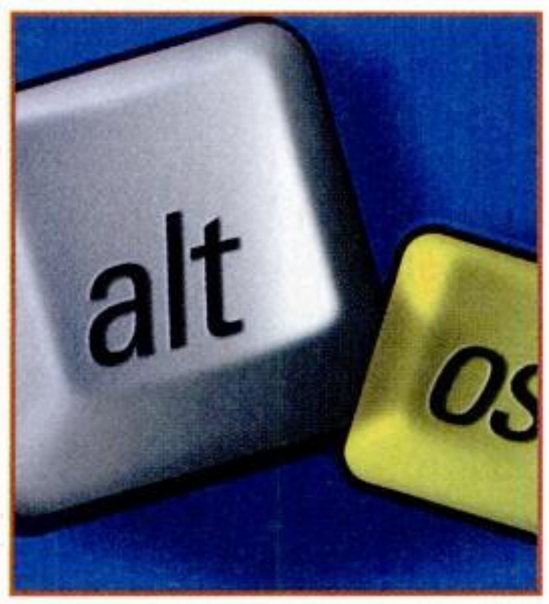

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EDWORD

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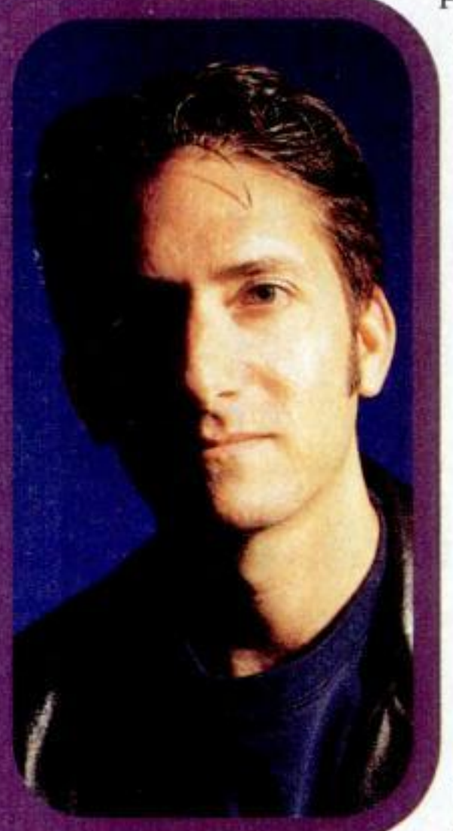

About a week after last month's issue hit the newsstands, a reader wrote in to protest the MP3 cover story teased in our Coming Next Month section. He felt that MP3 players are too far-removed from the basic PC experience; that PC power users don't care to read reviews of MP3-related products.

I respectfully but adamantly told him that I completely disagree.

Maximum PC believes that the MP3 phenomenon is the most important thing to happen to PCs since the advent of hardware-based 3D acceleration. Digital music has dramatically changed our lives, and has created a whole new use for PCs that five years ago we never would have imagined.

Ask yourself: How much time do you spend downloading music? How much time do you spend managing your file collection? To say that MP3 isn't an intrinsic part of the essential PC enthusiast experience is wholly absurd.

Maximum PC and its primordial inspiration *boot* magazine have always covered the cutting-edge of PC hardware technology—if the device can be hooked up to the box, it's part of our domain. This includes printers, game controllers, PDAs, and now MP3 players. Perhaps even more significantly, *Maximum PC* has always prided itself as your consumer advocate. And when an exploding but still immature phenomenon like MP3 rolls around, hardware vendors tend to flood the marketplace with crap. The careful consumer wants answers. Which player will delight me, which player will burn me? *Maximum PC* would be remiss in its watchdog duties if it didn't answer these questions. In fact, around this time last year, we published our first MP3 cover story, and it was one of our best-selling issues of all time. Do our readers care about digital music? Yes, indeed.

I think part of our critic's objections stem from the fact that he has always looked to *Maximum PC* for bread-and-butter, old-school upgrading advice (the very type of content provided in, say, our annual Dream Machine stories), and now he feels the magazine is straying from what he appreciates the most. I understand the reader's frustration, but need to inform everyone that we strive to offer an eclectic mix of coverage. Deep-inside-the-box upgrading advice is important, but it's only part of the *Maximum PC* equation. This magazine is about movement—forward and upward. When new technologies emerge, we cover them with vigor. We try to present a smart balance of meat-and-potatoes upgrading advice along with reports on just-condensed-vapor. This month, MP3. Next month, videocards. Variety is the spice of life. The magazine you're reading now includes features on alternative operating systems, supercomputers, and the IDE versus SCSI debate. We trust you'll find the mix to your liking.

Maximum PC is about movement—forward and upward. When new technologies emerge, we cover them with vigor.

A revolution is currently brewing in the PC ranks. Technologists are developing new and wonderful ways for you to use your computer as a central hub for entertainment, creativity, and information devices. Broadband modems, PDAs, digital cameras, and the list goes on. In the coming months, expect even more coverage of these types of products. The PC world is changing, and *Maximum PC* is changing with it. It's time for you, the reader, to help steer this revolution. Which product categories do you want explained and exposed? Please send your suggestions to **editor@maximumpc.com**.

—Jon Phillips

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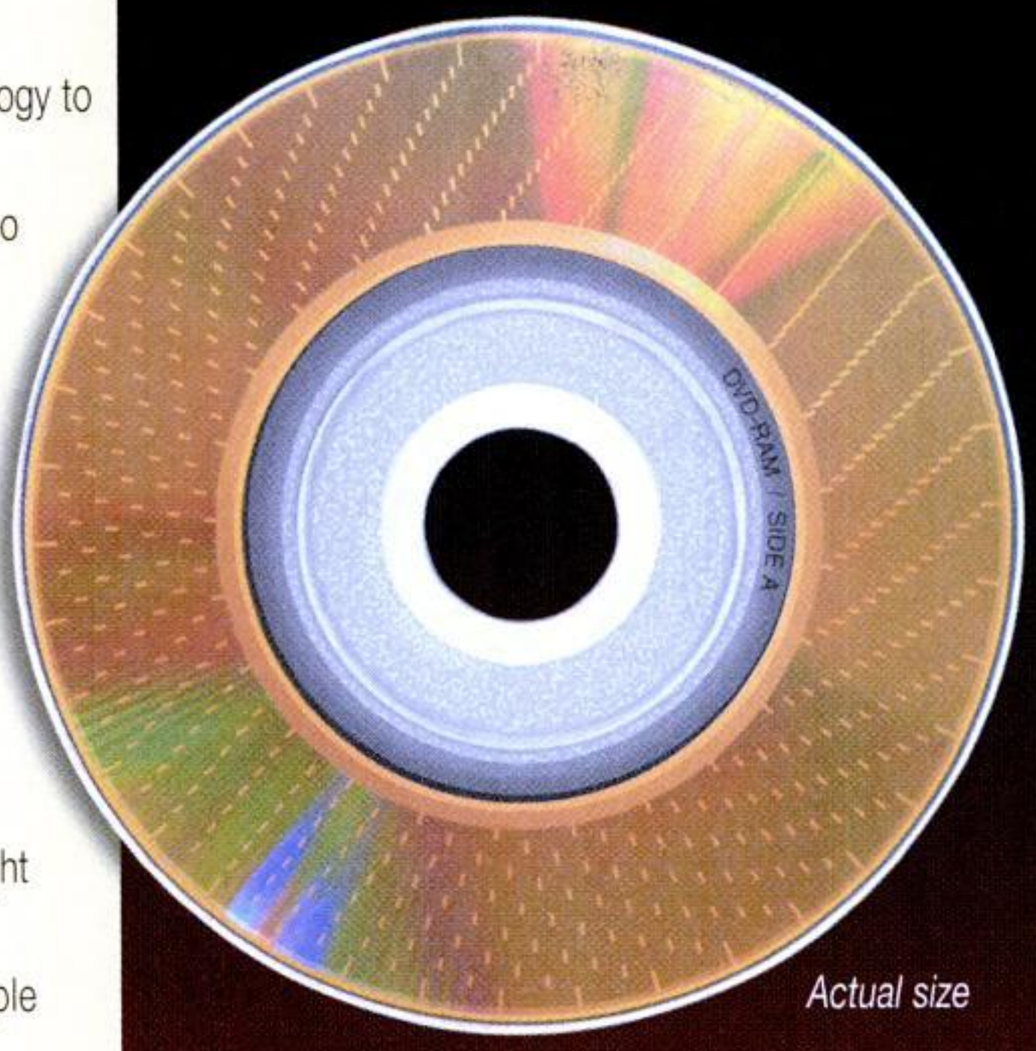

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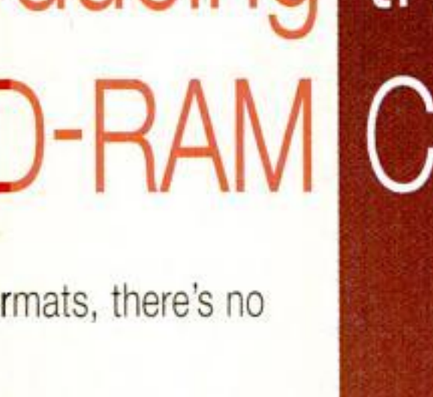

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Raising the Alarm

We get letters. Oh, yes, we get letters. Letters of praise, letters of disapproval, and, perhaps most frequently, letters that charge us with the sin of omission. Whenever we fail to mention the single product that everyone knows and loves, the masses rise up for the beatdown. This month, readers repeatedly dinged us for forgetting to mention the software firewall *ZoneAlarm* in February's "Broadband Experts Handbook."

Indeed, we carelessly forgot to mention *ZoneAlarm* last month. But we do know of the product's magic. In fact, it was included in our July 00 "Powerware" feature. As reader Paul Adams concisely described the software: "It works. It's easy to set up. It's a free download from **www.zonealarm.com**. Enough said."

And the Tribbles Just Went Nude

On page 58 of the February issue, in "Sometimes a Shortcut Is Just a Shortcut," you mistakenly state that the color of Gordon's Star Trek outfit represents "Command Class." A yellow uniform is, in fact, for Engineering. Red is for Command. Green/blue is for Medical. A true Trekie would never have made this error. And, no, I do not visit those geeky Star Trek conventions, but I do watch "Voyager" every now and then, and perhaps download an episode or three of "TNG" off ScourNET.

—Dev Mathur

Lt. Commander Gordon Mah Ung replies: I have no doubt that Captain Kirk himself would smash you in the chest with two interlocked fists for that remark. True fans of "Star Trek OG" know that in *that* series, Command wears gold, Engineering and Security wear red, and Science and Medical wear blue. Kirk occasionally wears a green tunic as well. It is in the kinder and gentler Jean-Luc Picard generation that Command wears red, Security wears gold, and Science and Medical wear green/blue. In the first six movies, everyone just wears red.

True fans of "Star Trek OG" know that in *that* series, Command wears gold, Engineering and Security wear red, and Science and Medical wear blue.

Broadband Inquisition

In your February "Broadband Experts Handbook," you state that ADSL connections don't work beyond 18,000 feet from your telephone company's Central Office. This isn't true. Using fiber-optic lines, the telco can set up a remote terminal at a distance far away from the main switch. Since the connection between the remote and the switch is over fiber-optics and not over "normal" copper, the speed of communication between the two is insanely fast. In essence, the remote becomes a "mini-switch" and the 18,000-feet rule now applies to the distance from the remote terminal and not the main switch.

—Tom Roberson

Technical Editor Will Smith replies: The key phrase in Tom's letter is "the telco *can*." Here's the deal: Even though some DSL variants, such as G.lite, will work well beyond 18,000 feet, the majority of residential DSL providers won't fool with repeaters or fibre-optic extensions due to their high cost (in respect to both equipment and support). In order to get service beyond 18,000 feet (or 15,000 feet, in some cases) most people will have to sign with a commercial provider, which will charge them out the nose. Our article focused on home consumer services.

What the hell kind of crack was Will Smith smoking when he wrote the "Broadband Experts Handbook"? He lists the maximum speed for SDSL as 1.5Mbps. Several companies offer 2.3Mbps SDSL in my area. What gives? He also lists cable speeds as being 1Mbps to 27Mbps! Give me a break! I know three people with cable, and on a good day they get 400Kbps maximum downstream.

—Dustin R. Newton

Technical Editor Will Smith replies: The DSL speeds we listed are the most common maximum speeds that providers will guarantee for the different variants of the technology. The 2.3Mbps provider in your area may be using proprietary equipment or selling a different type of synchronous DSL as SDSL. The cable speed we listed is the maximum speed delivered to each cable node as defined by the cable spec. Cable bandwidth is shared among every user on a node, and, in the real world, each user's downstream bandwidth will be limited to between 1Mbps and 10Mbps. It sounds like the people you know are on an oversaturated cable node and need to either complain to their providers or change services.

In the "Broadband Experts Handbook" section titled "Can you optimize your connection?" you suggest the values of PMTUDiscovery and MaxDupAcks. I searched my Registry for these strings, but didn't find them. What's up with that?

—Anonymous

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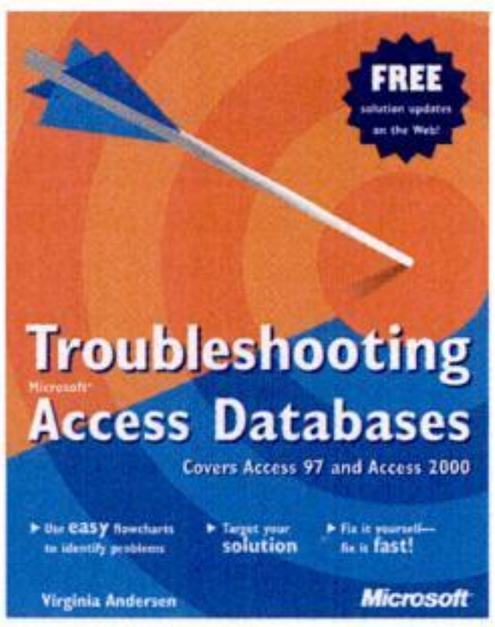
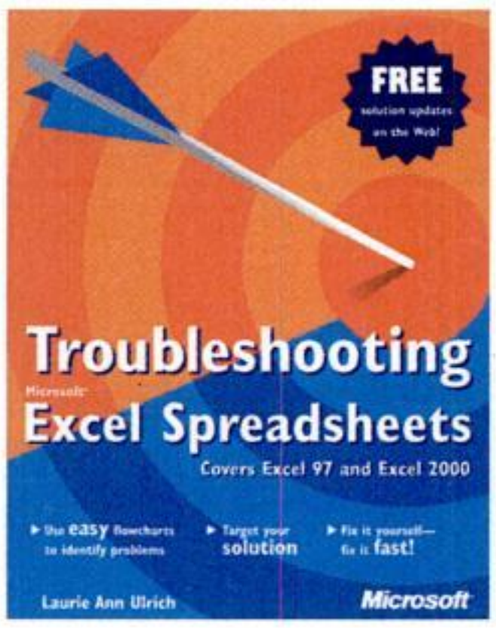
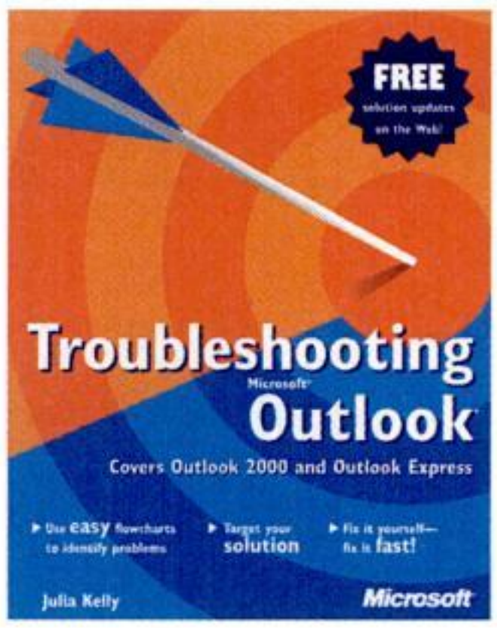
THE Computer PAGE.

Get on Target with Troubleshooting from Microsoft







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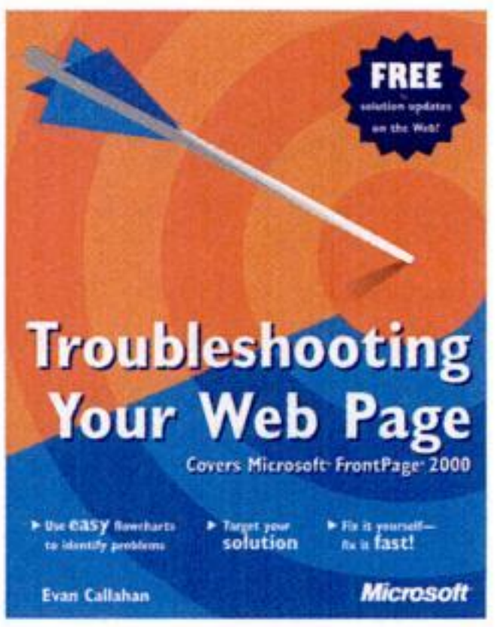

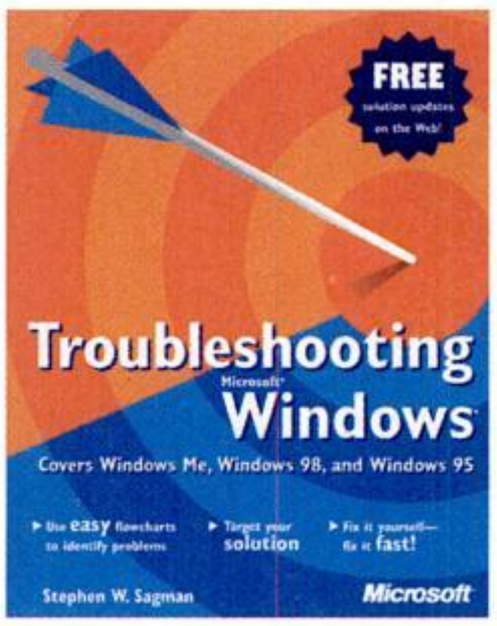

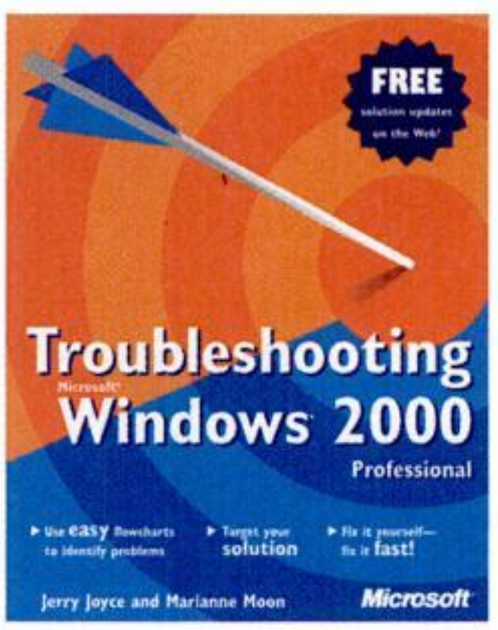

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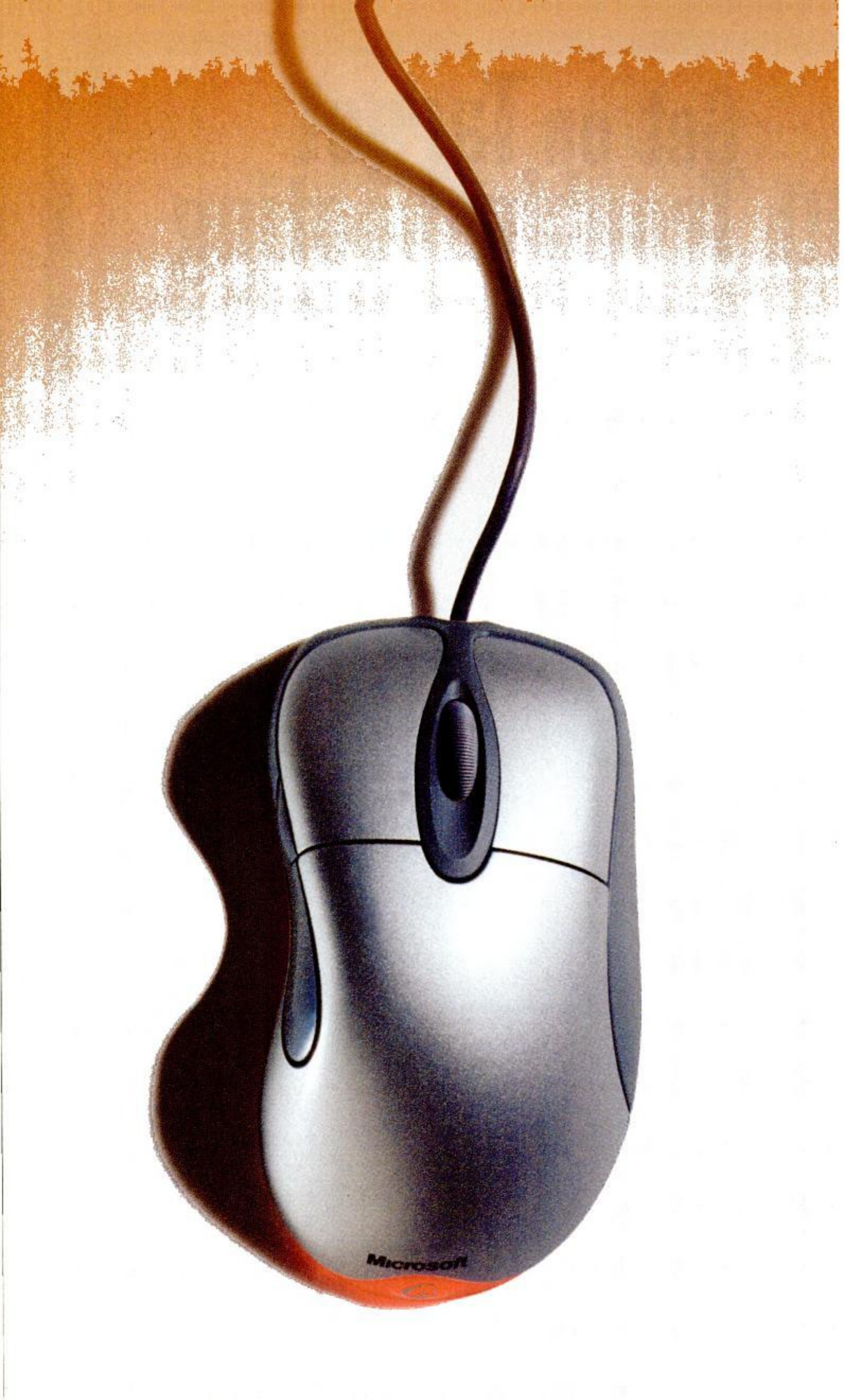

36-24-36

Technical Editor Will Smith replies: If the keys we mentioned aren't in your Registry, you can safely add them to the folders we listed in the article. PMTUDiscovery and MaxDupAcks usually reside in HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\VxD\MSTCP. Be sure to create both keys as String Values.

And It Rhymes With Stinks

Dudes! I enjoyed the article "Very Bad Things" in the February ish, but come on! Slapping that CD-R with a bunch of stickers isn't what caused the CD drive to react violently—it was the single Jar Jar Binks sticker. Even a lowly CD-ROM drive will have a queasy reaction when exposed to that CGI minstrel-show pile-of-ass. Just try this: Insert into your CD-ROM drive any Lucasfilm game that features said green Stepin Fetchit. The game will be spit back out while your computer makes retching noises and calls its union lawyer to inquire about a work-stoppage to protest unfair computing conditions. No Jar Jar, no peace!

—Errol Portman

Contributing Sticker Model-Cum-Pariah Jar Jar Binks replies: Meesa say yousa right!

Power-User Literacy Test

For the most part, I enjoy your "bad-ass outlaw" approach to computing. (Just no more shooting, please. Drop a computer off a building, à la Letterman, if you must. But no more shooting—too redneck-y.) But every once in a while I have to wonder what kind of people you have working for you. You have at least one writer and one editor who don't know the least bit about hard-drive design and construction. In the "Very Bad Things" article in your February issue, there is the statement "...we didn't expect any troubles from running a hard drive in topless mode."

Any pimply-faced 12-year-old knows that hard drives have carefully designed and controlled aerodynam-

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game store, and the ESRB rating program is costing my store dearly. Why? Because I choose to enforce the rating system and my direct competition does not. Kids know this, so not only is my store considered the "least-cool" place to buy games, but the kids also go right to my competition and, a few minutes later, come skipping by my store with their copies of *Diablo* or *Kingpin*, saying, "Hey! Your store sucks!"

And I don't get the negative reaction just from kids. I catch more you-know-what from Johnny's mom because she was dragged out of her shoe store so that she could purchase *Carmageddon* for her son. Maybe it's just my area of the country. I work in the Northeast where parents would gladly get smashed and have their 12-year-old kids hold their hair up while they puke in the toilet.

I say, if we're going to be forced to follow this rating system (a concept I have no problem with), then everyone should be forced to follow it. I can't afford to continue losing money over it, however. Not when competition is as close and vicious as it is. Parents, either get with the program and help enforce it or have it abolished by dealing directly with your congresspeople!

—Paul Silverstein

Playing With the Queen of Hearts

When I saw the pictures on the contact page of your web site, I just couldn't resist messing with them. Here's how to create these playing cards in *Photoshop*: Take a head shot and erase its background. Next, duplicate the image and turn the duplicate around by 180 degrees. Match up the ends, and begin playing with filters (I ran the Sumi-e filter). And there you have it—the editors of my favorite magazine as playing cards.

—Anthony Woicik

Did I Break the bootMark?

Did I just set a new *bootMark* record? I recently got my new system configured. Here are the key specs: AMD Athlon Thunderbird 1.1GHz overclocked to 1.25GHz (though I don't always keep it that high), Abit KT7-RAID motherboard, 256MB Crucial PC133 CAS2 RAM. I was just curious: Even though *bootMark* isn't used anymore in your magazine, is 670.6 a new record?

—Brad Boob

Senior Editor Gordon Mah Ung replies: A quick check of our records tells us that 670.6 is indeed a record-setting number in the *Maximum PC* scheme of things (and we'll assume that Brad didn't doctor his supplied screenshot in any way). We last used *bootMark* in the November 00 issue, and, at that time, 546.8 was the highest score we had recorded in the Lab (it was achieved by a 1GHz Athlon attached to an Asus A7V mobo, complemented by 256MB of PC133 SDRAM). I suspect a 1.2GHz DDR AMD machine may give your machine a run for the money.

Give yourself a gold-plated trophy for beating *Maximum PC*'s best recorded number. And give yourself a silver-plated plaque for having the guts to use your real name.

This NDA Will Self-Destruct In Five Seconds

Dear Jon Phillips (or at least the guy who reads his e-mail): Regarding your new NDA policy—do it! Become "old-fashioned sleuthing" reporters!

I can just see Josh sneaking around Microsoft in black PJs trying to dig up dirt on Bill Gates' newest OS. Or Gordon, decked out in Tom Cruise attire, crawling down a heating duct and reporting back to Scott (who, by the way, is painting his nails a beautiful new blue) to give him the all-clear to be dropped down into the room below. And on that desk in the room below is a folder reading "SCSI RAID: The Real Reason It Doesn't Work."

Will and Kristen would be in the sur-

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veillance truck listening to Moby bootlegs and watching *Pecker* on DVD, trying to figure out what's taking Josh so long, and asking, "Where the hell is Geoff with the doughnuts and Zingos Extra-Strength Caffeinated Peppermints?"

All this sleuthing would be more work, but wouldn't it be satisfying to publish the first article on the new high-speed Internet satellites (35Mbps up, 35Mbps down)? No more NDAs!

—Brett Lestition

Editor-in-chief Jon Phillips replies: Ah, if I only had an assistant to read all my e-mail! Actually, each person on our small staff of eight editors and two designers reads his or her own e-mail—and some of us read the mail that's sent to other maximumpc.com addresses (thanks, Gordon and Scott). I myself read at least the first 100 to 200 words of every single letter that comes to editor@maximumpc.com and commport@maximumpc.com. If I find a letter to be important or intriguing, I continue reading and oftentimes reply.

As for Brett's sleuthing scenario: Whoah! This guy really knows the *Maximum PC* staff! Either someone's been sneaking around our offices in his own black PJs (ahem, not pointing any fingers), or someone's been reading the magazine from cover to cover, collecting all the tiny bits of personal minutia that we leave behind. Regardless, the new NDA policy is proceeding nicely—we've already rejected three NDAs this week.

CUT, COPY, PASTE

▶ In the February issue, we published two incorrect URLs. The correct URL for Lite-On Enclosure is **www.liteonenclosure.com**. The correct URL for SP-North America is **www.spusa.com**.

▶ In February's Inside Sources ("The Road to 3GHz"), we incorrectly used the term DEFCON 5 to signify a nuclear doomsday emergency. In fact, DEFCON 5 means the U.S. military is in a state of peace. DEFCON 1 signifies the authorization to use nuclear weapons. ✸

Hard Disk Copy Protection

How the anti-piracy movement could possibly affect new IDE drives

Just when you thought everybody had endured enough of the copy-protection-spec-turned-disaster-flick known as the Secure Digital Music Initiative, four technology companies have proposed what could be an even more disastrous sequel: Copy Protection for Recordable Media (CPRM).

CPRM would make devices such as flash memory and Zip disks check for copy protection on files before they could copy those files. What's troubling is that the four companies pushing CPRM—Intel, IBM, Matsushita, and Toshiba—hope to insert the technology into the ATA spec, which governs PC hard drives as well.

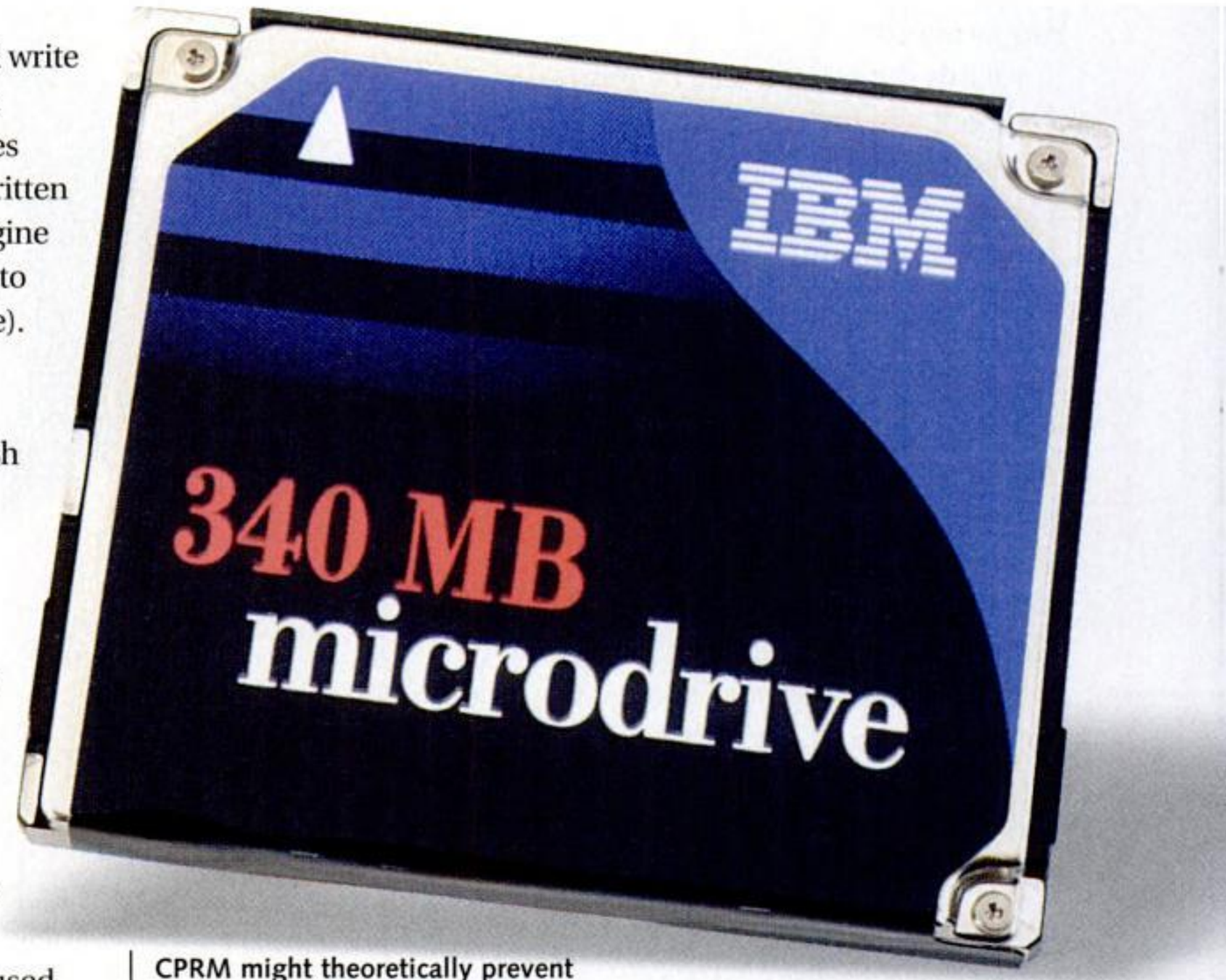
Hard drives with such refusal-rights aren't exactly user-friendly, and free-software advocates including Richard Stallman and the Electronic Frontier Foundation's John Gilmore say CPRM takes the control out of consumers' hands and gives it to the content providers.

A counterproposal that includes a provision to let people turn off CPRM has been floated, but this solution carries its own problems: A CPRM-disabled drive could indeed write copy-protected data, but CPRM-aware content files could still refuse to be written to such a drive (just imagine Microsoft *Word* refusing to install on your hard drive). Already IBM has plans to add CPRM to its Microdrive CompactFlash units, and flash-RAM maker SanDisk says it wants CPRM as well.

Intel says that desktop hard drives are off-limits and that the ATA governing body is only involved so that Microdrive and similar ATA removable formats are covered.

"It's not going to be used on hard drives," says Intel spokesman Chuck Mulloy. "Stimulating demand for PCs is one of the core parts of our business. It's [the consumers'] hard drives, and that's why we won't license this for hard drive manufacturers. It's your content, as a consumer, on your PC."

Of course, some people ask why tech companies would bother proposing CPRM in the first place? It's simple, says Steve Vonder Haar, an analyst with Boston's Yankee Group: "If you can get content providers to buy into the notion that it behooves them to move into digital formats, processors and systems by companies such as IBM and Intel suddenly have a whole new realm. If they make digital devices more viable, they create more demand for digital products."



CPRM might theoretically prevent you from storing copy-protected music, video, or software on your hard drive.

Rob Enderle with Giga Information Group is unconvinced that CPRM can truly bridge the gap between consumers and reticent content companies. "This idea of providing a technological solution to what is more a social problem, given the capabilities we have out there, is just asking for failure," he says.

—Jason Compton

SPIN CYCLE This month's top stories broken down ▶

HEADLINE	NEWS	DETAILS	THE SPIN	OUR TAKE
XBox Details Take Shape	Microsoft has issued finalized specs for its PS2 killer, revealing higher CPU speed and lower graphics clockspeed than initially planned.	The XBox spec has changed from a 600MHz Intel CPU to a 733MHz CPU, and from a 300MHz custom nVidia graphics chip to a 250MHz custom nVidia chip.	"Building on our strengths as a software company, XBox will offer game developers a powerful platform and game enthusiasts an incredible experience," says Microsoft.	Despite worries that XBox will gut PC sales, we predict the console will only bolster PC gaming because of the shared development platforms.
More Computers, Less Sex	A survey of 1,000 Americans last fall found that 1 in 12 men say they have less sex because they're playing with computers or gadgets.	*Playboy* magazine's Man Track survey also found that men in general are spending less time outdoors, playing sports, and exercising, and owned seven consumer electronic devices, on average.	However, if stranded on a deserted island, the study shows 75 percent of men would rather have a beautiful woman instead of a CE device.	Is it less sex in order to play with computers, or less sex *because* they play with computers?

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Where's the DDR?

It promised to double PC main memory bandwidth for little more than the price of standard memory. But now it looks as if DDR memory isn't enjoying the flawless launch that was predicted.

PCs using both DDR memory and AMD's new 760 DDR chipset were supposed to be available from Micron PC before December 2000. An embarrassing set of glitches, however, sidelined the high-speed memory by several months. Micron PC officials say transient electrical noise cropped up on some motherboards using the faster 266MHz system bus and PC2100 memory. The problem forced Micron PC to instruct its contractor to redesign its motherboards with noise filters.

AMD says Micron's motherboard problem doesn't really affect its own schedule. AMD says DDR systems and Thunderbird CPUs with 266MHz frontside busses will be widely available by the time you read this.

Another nagging concern for DDR proponents has been the legal success that anti-DDR company Rambus has had of late. Rambus has sued almost two-thirds of the world's memory makers into paying it royalties for almost all types of PC memory. Some fear that Rambus' litigation could lead to higher-priced DDR memory, which would hurt its adoption.

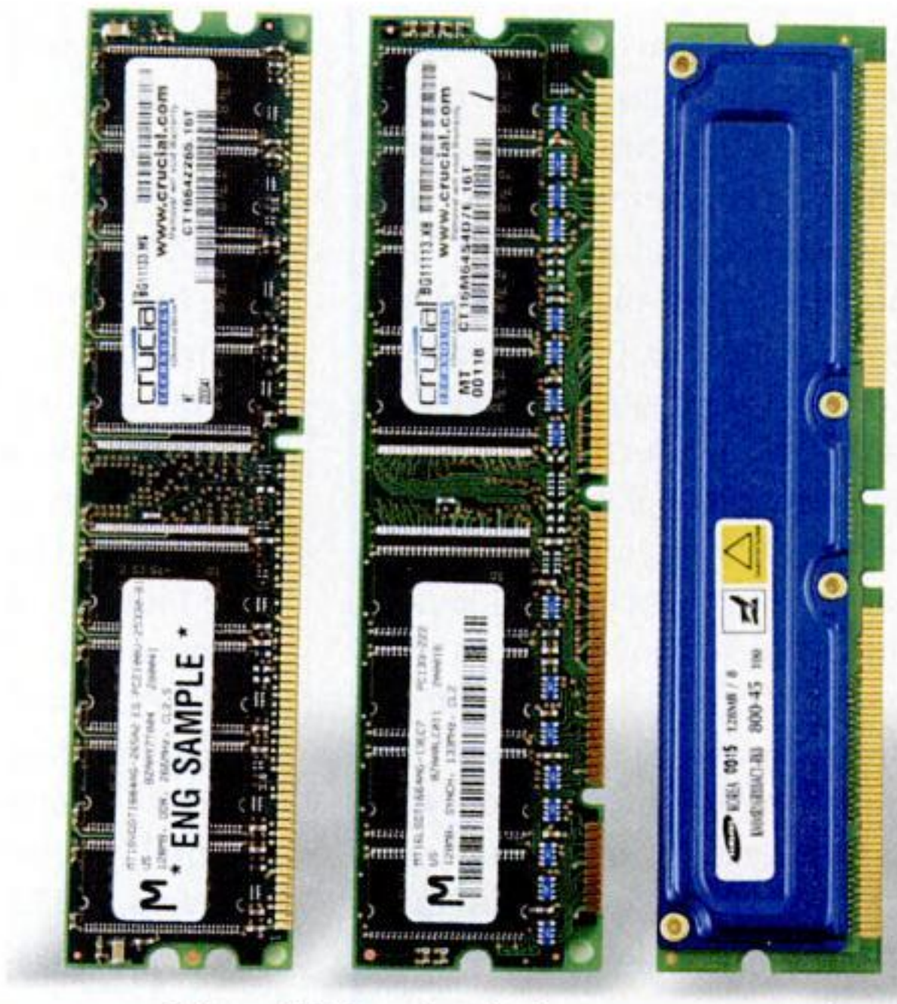
But DDR supporters say that isn't happening. Memory maker Crucial Technology says it's seen great demand for DDR memory.

"Since we launched DDR to the consumer market, we've sold much more than we thought we would," says Sean Spence, a spokesman for Crucial Technology.

Spence said DDR's adoption may actually be less painful than other transitions, and Crucial Technology is offering the PC1600 version of DDR at the same price as PC100 SDRAM. "That's unheard of in our industry," Spence says. Fantastic pricing aside, one aspect Spence didn't note is that Crucial Technology's inventory only includes PC1600 memory. The faster PC2100 memory wasn't yet being sold at press time.

Dean McCarron, a principal analyst at Mercury Research, says it's jumping the gun to say that DDR *won't* happen.

"I would actually say it's the opposite," McCarron says. "New system memories tend to have pretty slow starts. There's a lot of infrastructure that has to be touched here—memory modules, sockets, electrical characteristics, system logic support."



DDR SDRAM (left) will likely replace both PC133 (center) and Direct RDRAM (right) memory once the teething pains are over.

AMD's 760 chipset may not have been available in time to make everyone happy, but alternative chipsets from ALi and VIA Technology are available for both Intel and AMD CPUs. Motherboards using ALi's ALiMAGiK (for Athlon) and Aladdin Pro5 (for Pentium III) were already available in January. Motherboards using VIA's KT266 chipset (for Athlon) are expected to be on shelves by March.

Despite consumer concerns, McCarron said DDR memory is a done deal and will be the standard memory for the next few years.

—Gordon Mah Ung

to the pertinent details.

HEADLINE	NEWS	DETAILS	THE SPIN	OUR TAKE
ATI Outlines Roadmap	ATI says it should have its second-generation Radeon, called R200, out this summer.	The R200 will be followed by the R300 in 2002 and then the NA4. All promise to be graphics chips on par with nVidia's best.	"Our mantra is, 'Radeon everywhere and for everyone,'" says ATI.	No one wants an nVidia graphics monopoly, but we get worried when companies pre-announce products by a year.
New Cooler May Make Devices Thinner	Using a capillary system, Novel Concepts, Inc. says its new IsoSkin head spreader will let companies build cooler, smaller devices.	IsoSkin can be thinner than a credit card and five times more efficient than a copper heat pipe, yet tough enough to be used on the outside of a device.	"With wireless and integrated circuit data rates skyrocketing, power dissipation quickly becomes a chief obstacle," says Novel Concepts.	IsoSkin and technology like it are long overdue in portable devices.

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Intel Redefines Your PC

It's All About Gadgets—the Pentium 4 Be Damned!

You've already bought an Intel processor—so now it's time for you to buy an Intel camera, Intel MP3 player, and Intel webpad. That's the message the chip giant pimped at the annual Consumer Electronics Show, where it trotted out a bevy of gadgets, including an MP3 player and an instant-messaging pager.

Though Intel's high-profile appearance at the world's biggest gadget show may put its shareholders at ease, the company's move to sell Intel-branded cameras and MP3 players may send a shiver down the backs of PC traditionalists. Is the chip giant so worried about the future of the PC that it's looking for profits from toy and gadget sales?

Adding fire to the flames of conspiracy theory is Intel's glaring lack of marketing for its new Pentium 4 CPU. Months after launching its flagship processor, Intel is still pushing the Pentium III with its Blue Man Group ads. Why is Intel sitting on the P4 when AMD is all over it like a bad suit?

The answers to these questions may be less sinister than you think, according to Intel and analysts. While it may be true that Intel is pushing gadgets, the company says these gadgets are not intended to replace the PC, but rather to make it more valuable.

"The PC is at the center of the digital universe and the universe is expanding," said Intel CEO Craig Barrett in his CES keynote. "I think increasingly the value of the PC is really associated with the number of these consumer interface devices we have attached to the PC."

Intel believes that the more digital cameras and MP3 players people buy, the more those people are going to want to buy a new PC to process the data.

Intel acknowledges that it hasn't pushed sales of the P4, but says the strategy shouldn't be construed as a retreat from the CPU. Instead, Intel says, its marketing strategy is keyed into availability. Intel manufactured only a few hundred thousand P4s last year—far fewer than the tens of millions of P-IIIs it fabbed. Intel says that as it ramps up production this year, the Pentium 4 will have the coming-out party it deserves.

One analyst paints a less rosy picture of Intel's changing of the CPU guard. "They're just in that spot where it's not fun," says Dean McCarron, a principal analyst with Mercury Research. "Intel doesn't want to Osbourne the P-III and not deliver the P4."

—Gordon Mah Ung

3dfx Dies

Graphics Celebrity Succumbs to Accelerating Illness

The PC world is mourning the loss of 3dfx, which died recently after a long fight with financial cancer. It was 6.

Best known for its work in "Voodoo"—the 3D-gaming tour-de-force that set the stage for a new generation of PC graphics cards—3dfx will be remembered for its ability to transform wireframe models into lifelike characters. 3dfx, then using the stage name 3Dfx, followed its popular one-man show with "Voodoo2," which wowed critics everywhere.

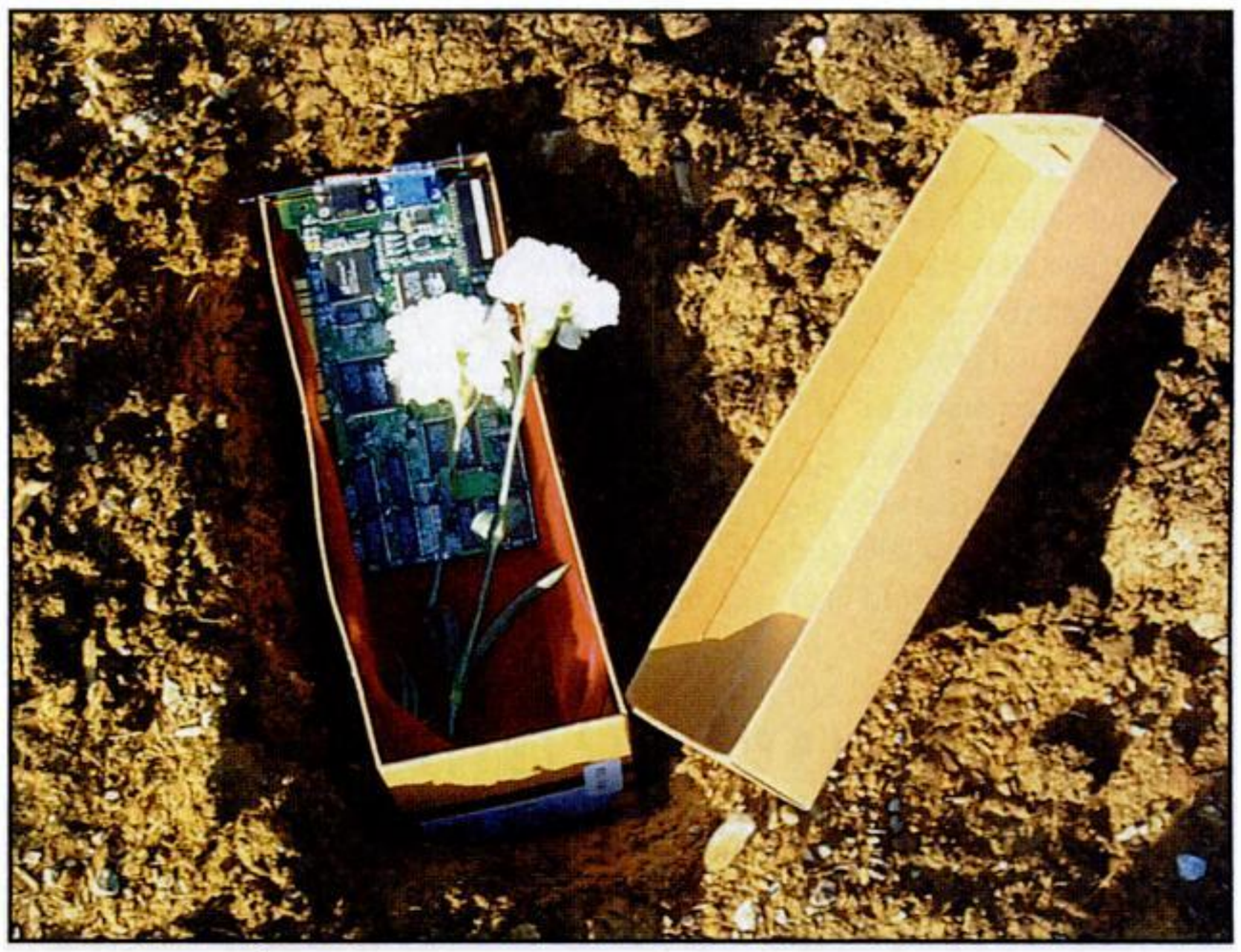
But despite audience adulation and standing-room-only crowds at small venues such as Alienware and Falcon Northwest, 3dfx never really broke into the major arenas of Dell, Gateway, or Hewlett-Packard.

Critics say the problem was 3dfx's unusual reliance on another graphics card to complete its routine. During its lifetime, 3dfx was also haunted by high-profile affairs with Diamond Multimedia, Creative Labs, and Canopus. 3dfx finally married STB in 1998.

The deceased tried to reinvent its act several times in recent years, most notably in "Voodoo Banshee," but critics and even loyal fans universally panned this revue. 3dfx finally returned to the limelight with "Voodoo3" and later "Voodoo5," but by then true PC entertainment success had escaped it. Financial cancer spread throughout its body, and 3dfx died in its sleep.

Having willed its estate to estranged half-brother nVidia, 3dfx was laid to rest at All Saints Church in San Jose, CA.

—G.M.U. .



3dfx: 1995-2001. It will be missed.

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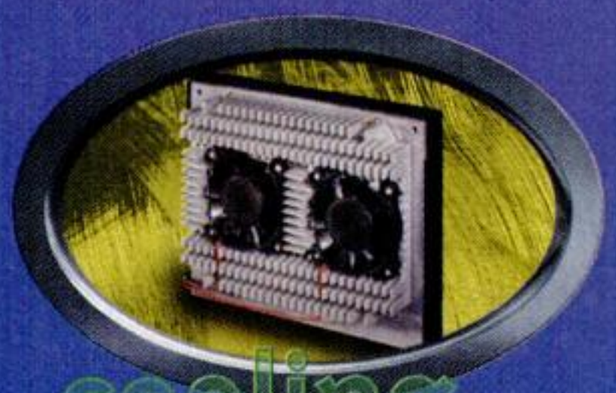

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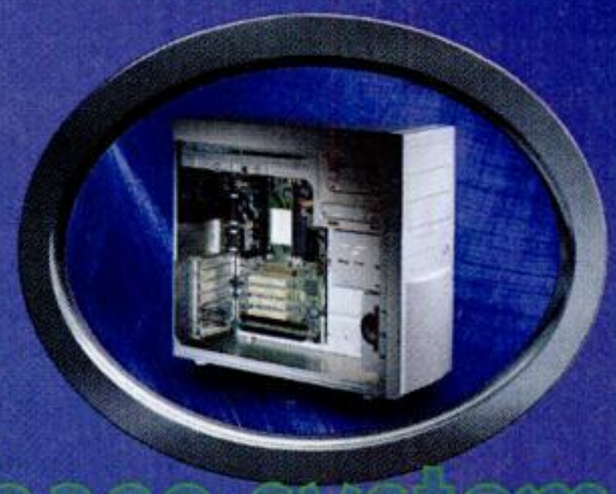

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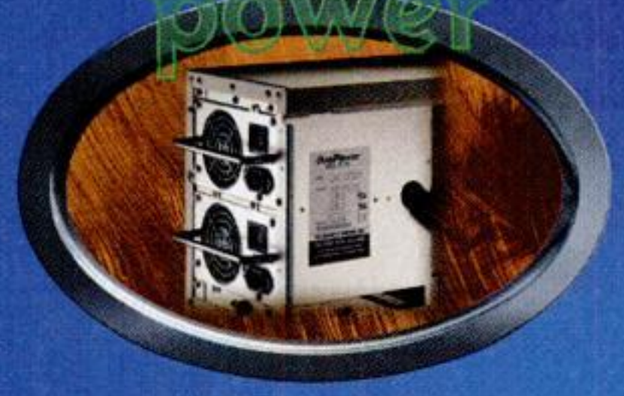

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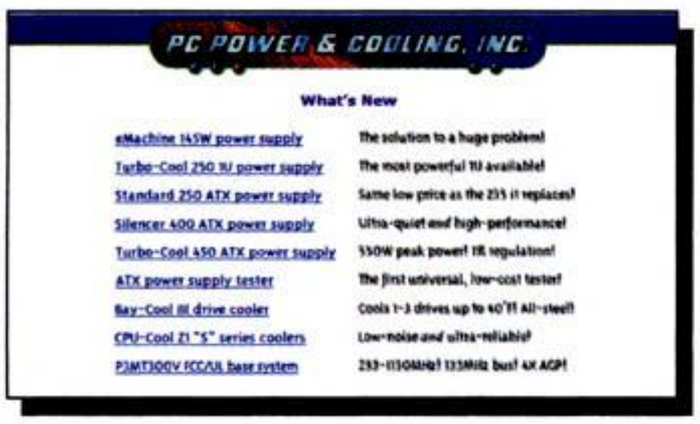

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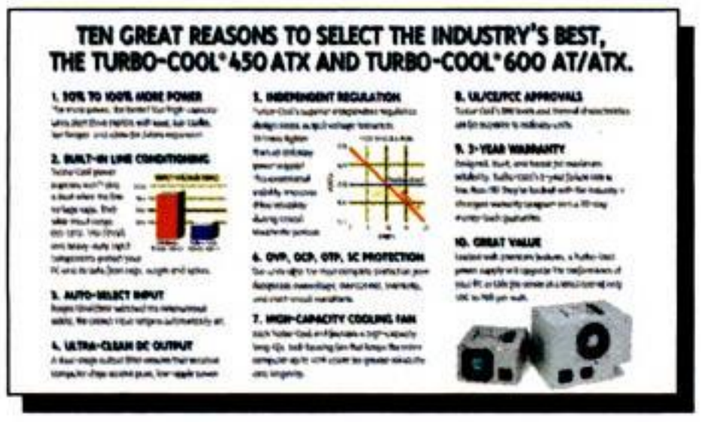

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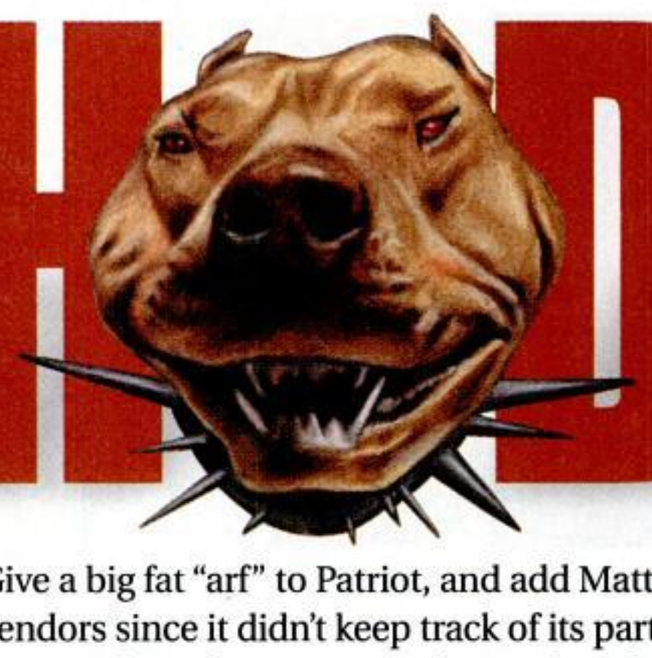
ILLUSTRATION BY SCOTT LAUMANN

▶ **Maximum PC takes a bite out of bad service and gear**

WATCHDOG



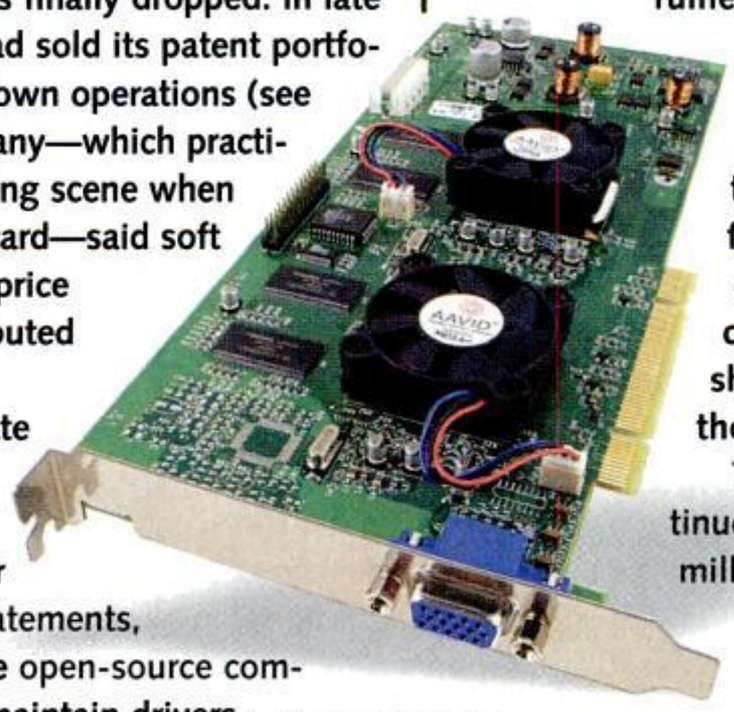
Got a bone to pick with a vendor? Been spiked by a fly-by-night operation? Sic The Dog on them by writing Watchdog @maximumpc.com. The Dog promises to get to as many letters as possible, but only has four paws to work with.

3DFX DRIVER UPDATE

The other shoe in the 3dfx drama has finally dropped. In late December, 3dfx announced that it had sold its patent portfolio to rival nVidia and would wind down operations (see our obituary on page 16). The company—which practically defined the power-user upgrading scene when it introduced the first Voodoo videocard—said soft PC sales, stiff competition, memory price increases, and product delays contributed to its demise.

The end of 3dfx will likely translate into dark times for its loyal customers. At press time, 3dfx said it had no plans to release further driver updates and, contrary to previous statements, no plans to release driver code to the open-source community or have third-party vendors maintain drivers.

Despite all this, 3dfx isn't discouraging anyone from buying products that remain on store shelves. All rebates will be honored and technical support will be offered for the first few months of 2001. The Dog, however, recommends that you avoid purchasing 3dfx products. Without driver updates and operating system upgrades, the cards will be quickly rendered irrelevant. Woof.



Buyer beware. Future driver support for 3dfx cards such as this Voodoo5 5500 PCI is unlikely.

UNPATRIOTIC COMPUTER CORPORATION

Dear Dog: I never thought I'd have to write to you, but my sister and her husband have been bitten. They purchased a Hot Wheels PC for their 7-year-old son around Halloween. With upgrades, the Hot Wheels PC cost about $1,800. I helped them set up the new toy on Christmas Eve and ran into several problems. The printer, an Apollo P-1250i, didn't work, the computer came with the Latin America version of *Norton Anti-Virus*, and the *CorelDraw 9* CD was corrupt. I tried to contact the manufacturer of the machine, Patriot Computers, to no avail. It turns out Patriot has gone bankrupt. I also tried calling Mattel but could never get through. Give a big fat "arf" to Patriot, and add Mattel to the list of bad vendors since it didn't keep track of its partner's financial situation. I bet a lot more people were hurt by this company than just my relatives.

—Terry Cornett

The Dog Responds: Terry's assessment is right. The Canadian-based PC company known as Patriot may have ruined Christmas for thousands of kids who waited in vain for Santa to drop off a properly working Hot Wheels or Barbie PC. According to the trustee handling the bankruptcy, Patriot cashed in orders for some 3,500 PCs before it shut its doors on December 7, 2000. Because the company carried such large debt, it won't ship out any more PCs or offer refunds for those already purchased.

The trustee said Patriot had hoped to continue operating by securing an additional $24 million in cash, but when that fell through, the company fell down.

Though Mattel didn't manufacture the computers, it is making a cursory effort at appeasing dissatisfied customers. Mattel officials say the company will give $100 gift certificates to the 3,100 people who ordered Hot Wheels and Barbie-branded PCs.

Trustees say they have taken steps to notify as many Patriot customers as possible. If you haven't received a claim form, please contact KPMG, Inc. at 416.777.8704. What are the chances of Patriot making any payouts? Slimmer than Ally McBeal. As with most bankruptcies, there's far more debt than assets.

Not all is lost, however. For those who purchased the computers using a credit card, contact your card issuer to dispute any charges. In general, credit card companies will reverse charges for products that were never delivered.

"Though Mattel didn't manufacture the computers, it is making a cursory effort at appeasing dissatisfied customers."

I WANT IT ALL

When I purchased my computer, I was expecting a CD with Microsoft Windows ME. Instead, Dell sent a "restore disc" that is supposed to solve all my problems if I reformat or install a new hard drive. Four years ago, I bought a computer from a local store and they gave me an official Windows 95 installation CD in case a reformat was necessary. I expected the same (or even better) from a top-name PC maker.

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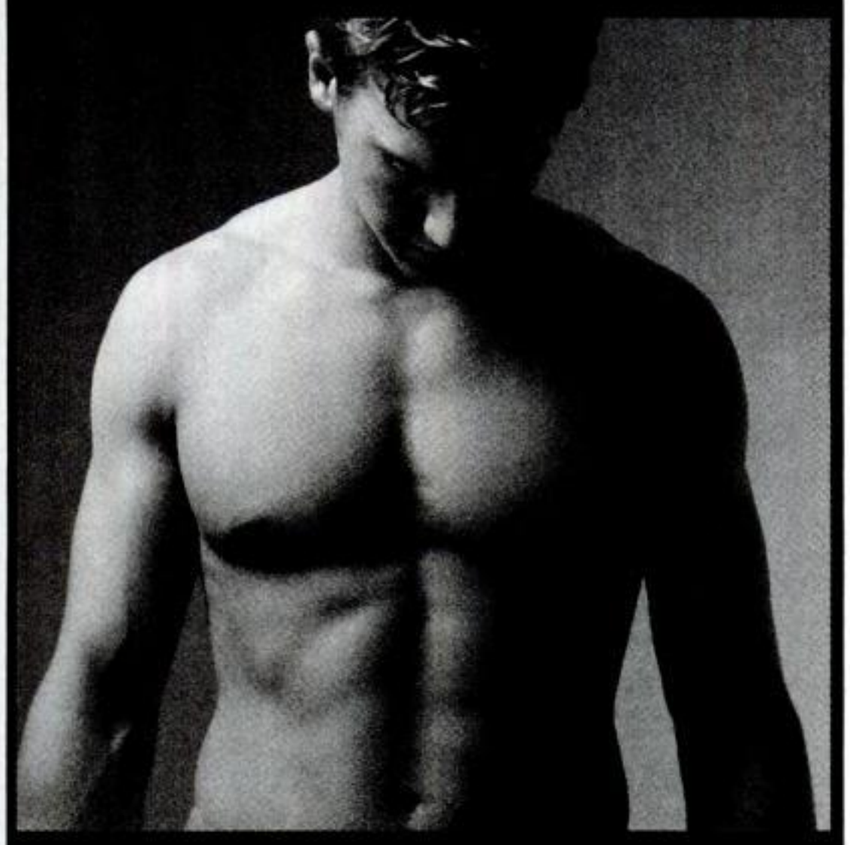
Voodoo Envy



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However, I never got that Windows ME CD.

When I called to ask why it wasn't sent, I was told the restore disc should suffice. Dell could just as easily have sent a computer without the OS, and I would've bought ME myself. I know the main reason is to prevent piracy, but I'm not satisfied. I'm actually going to have to buy my own copy just because Dell and Microsoft are being stingy.

—*Mike DiMeglio*

I was burned a few months ago by Hi-Val when it went out of business before paying me a $20 rebate on a Hi-Val CD-R drive. Are they back up and running, or is this some scam?

—*Stephen Laminack*

This old 6x Hi-Val DVD-ROM drive no longer carries any rebates, but newer and faster drives sold by the company that bought Hi-Val should all have valid rebates and warranties.

The Dog Responds:

Restore CDs are becoming standard issue with almost all new PCs, and that's not necessarily bad. In fact, we've dedicated many pages in the magazine just to teaching people how to create restore CDs for their own PCs.

There are actually several reasons for restore CDs. The first is piracy protection. Gone are the days when a person could install the same copy of Windows on 10 machines using the single disc he received with a computer. The second reason is technical support. While many *Maximum PC* readers wouldn't hesitate to reformat and reinstall, most people want to simply insert the CD and format and reinstall with a single mouse click.

"Soyo will prosecute anyone who manufactures or knowingly sells fake Soyo product."

Also keep in mind that many computer companies no longer have the choice of what to bundle. Several large PC OEMs told The Dog that Microsoft licensing dictates the use of restore CDs. Microsoft itself has moved away from the days of printing and distributing tens of millions of Windows CDs and encourages OEMs to download images that can then be tailored to individual machines.

The Dog Responds:

Stephen is just one of many readers who wants to know if it's safe to buy Hi-Val equipment again. According to Tony Shahbaz, president of IOM Holdings, Hi-Val products on store shelves should be fully covered by rebates and service agreements. IOM Holdings purchased Hi-Val's name and assets in June 1999. Hi-Val's bank ordered the company into foreclosure after its debt grew unmanageable. Shahbaz told The Dog that most of the rebates should identify IOM Holdings in the ad or coupon. Most of the products sold by IOM under the Hi-Val name are also new, so it's unlikely that you'll find a 6x DVD-ROM drive from the new Hi-Val.

SCAMMED?

Dear Dog: Is this a scam or just plain-old fraud? This weekend I saw an advertisement that had a Hi-Val CD-ROM drive kit for $19.99 after a $20 manufacturer rebate.

SOYOLENT GREEN

First it was counterfeit copies of Windows and phony Microsoft mice. Then it was bogus copies of Adaptec SCSI cards. Now, Soyo says it has confiscated more than 1,000 imitation Soyo motherboards. The boards were confiscated from stores in South America, Asia-Pacific, and Canada. Soyo officials say there have been no reports of counterfeit boards in the United States.

"Soyo has hired a legal investigation team and will prosecute anyone who manufactures or knowingly sells fake Soyo product," a spokesman for Soyo says.

Can anyone actually create an imitation motherboard cheap enough to make a profit? It seems so. Soyo isn't the only motherboard manufacturer to suffer at the hands of copycats. Asus boards were the target of counterfeiters years ago.

How do you avoid getting a bum Soyo motherboard? Well, none of the bad boards were being sold through legitimate Soyo distributors, officials told The Dog. So to avoid getting a fakey, you should purchase your hardware from a vendor on the company's approved list. That list is available at **www.soyousa.com/wheretobuy.html**.

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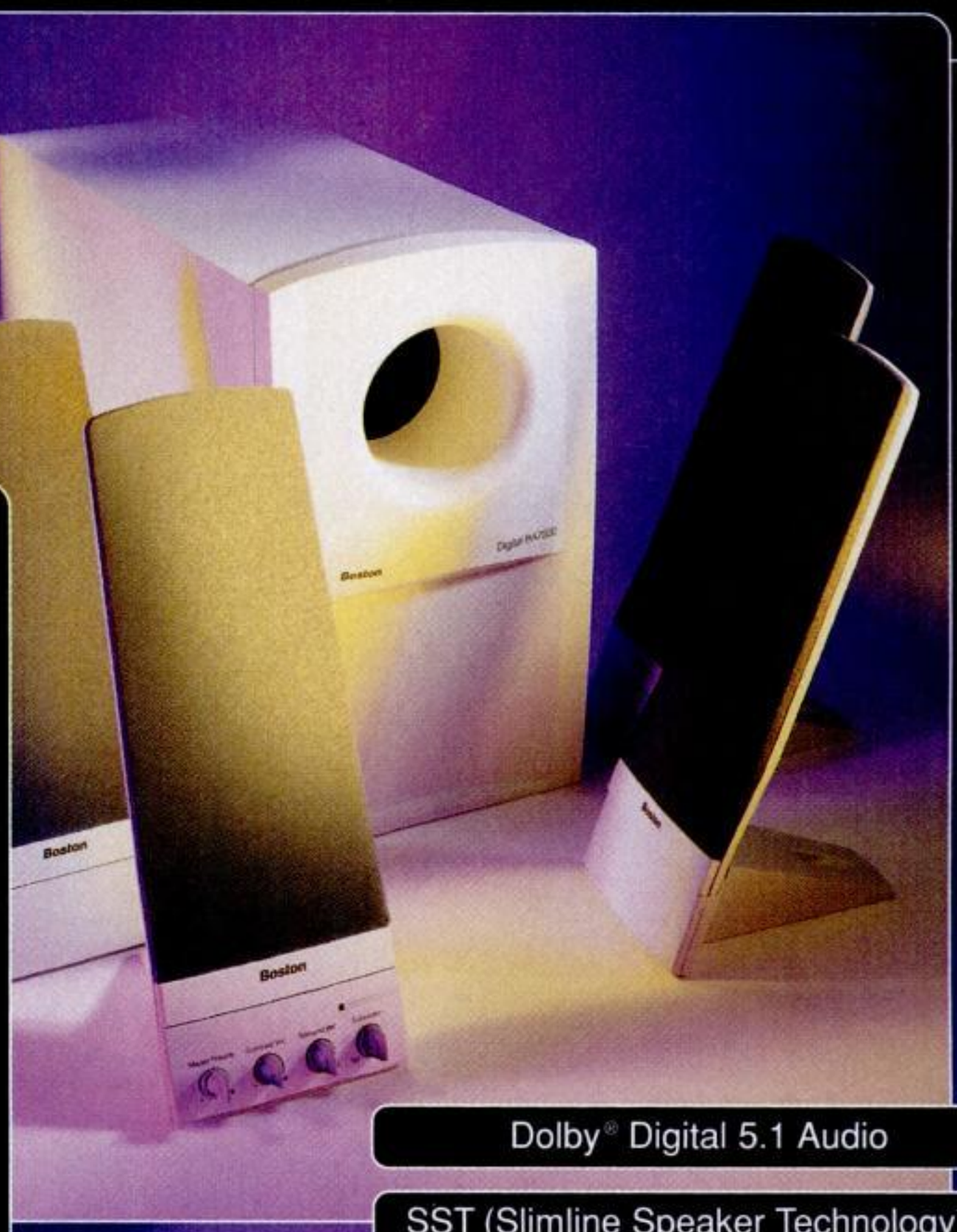

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PERIPHERAL VISION

3com Audrey

The first thing you'll notice about the Audrey is its svelte curves and subdued colors. Audrey is designed to fit unobtrusively in your kitchen or den. She sports a 6.25x4.75-inch touch-sensitive screen, but most of your input will be made with a micro-sized infrared wireless keyboard.

3com's Audrey is the first Internet Appliance we've seen that does more than just simple web browsing and e-mail. By connecting a Palm cradle to Audrey, you can sync two different Palm devices to the IA so you can view both calendars—and the main Audrey calendar—on the Audrey's screen. It's like having a corporate-type scheduling server for your household.

Don't confuse Audrey with a webpad, since it isn't one. Unlike a webpad, Audrey is permanently tethered to the wall for both power and net access (via USB Ethernet or modem).

For a busy Palm-equipped household, Audrey offers a way to keep everyone's schedules in sync.

$550 | 3com | 800.638.3266 | www.3com.com

Sharp DV-L80U

There's nothing quite like privately watching movies on the airplane to arouse jealousy and anger in your fellow cattle, er, passengers. And there's nothing quite as satisfying as firing up "The Sopranos" while everyone else is forced to sit through *Jerry Maguire* for the *n*th time.

Once you've finished yanking your plane-mates' chains, you'll notice that the Sharp DV-L80U is a great little DVD player. The DV-L80U sports an 8-inch LCD screen with an aspect ratio of 16:9, perfect for movie viewing.

In a pinch, the DV-L80U could also serve as your primary home DVD player. It even includes a S/PDIF for digital audio output and a remote control for—gasp—controlling it remotely.

If you already have a decent DVD-equipped laptop, the DV-L80U probably won't grab you. If, on the other hand, your DVD viewing is currently confined to the couch, the DV-L80U is worth looking at if you're looking to go portable.

$1,300 | Sharp | 800.237.4277 | www.sharpelectronics.com

Kensington Flylight Notebook USB Light

Rarely are we sent a product that inspires as much ridicule in the Lab as the Kensington Flylight did. Our tune changed the next day, however, when Will was rooting around under his desk, cursing the nest of cables shrouded in darkness. Although it's not the intended use of the Flylight, we plugged the pliable USB light into a USB port on the rear of his PC, and the visibility problem was solved.

Of course, this USB light is meant to illuminate a laptop during nighttime computing sessions, but any way you look at it, this is still a lightbulb, so we recommend it for anytime you need illumination. No power source is required, and the white LED bulb lasts up to 100,000 hours (we're currently testing this claim in the Lab—look for our report in 2013).

$20 | Kensington | 800.235.6708 | www.kensington.com

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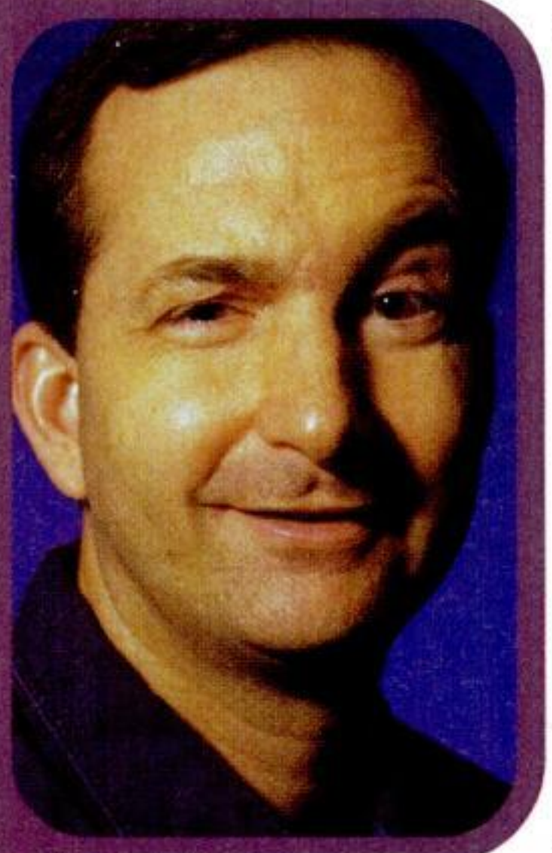
FAST FORWARD

Why Digital Cameras Suck

...AND HOW THEY'LL IMPROVE DURING THE NEXT THREE YEARS

Has digital photography finally come of age? Apparently so, if the zooming sales of digital cameras mean anything. But digital technology still has a long way to go before it fulfills the perennial prediction that it will make conventional photography obsolete.



TOM HALFHILL
was senior editor at *Byte* magazine and is regarded as one of the most knowledgeable experts on processor technology in the industry. Contact him at **thalfhill@maximumpc.com**.

Let me declare my bias up front: I think almost all digital cameras suck. But the good news is they suck less and less all the time.

For some purposes, digital photography is already as good as it needs to be. If you want to view photos onscreen, even a low-resolution 640x480-pixel camera is good enough. A one-megapixel camera—now widely available for $200 to $300—leaves room to crop the image and still fill the screen.

A friend of mine who sells rare rocks on the web uses a macro-focusing digital camera to photograph his specimens, because the extra quality of a film camera would be wasted for online photos. Likewise, photos intended only for e-mail to friends and family don't need more than one megapixel of resolution. In fact, larger images take more time to upload and download. (Do your long-suffering recipients a favor and downsize your photos to about 600x400 pixels before sending.)

Prints, not video screens, are the ultimate photographic battleground. When digital cameras and printers can produce color prints in popular sizes that match the quality and cost of prints made with film cameras, film is doomed. We're close, but not quite there yet.

Some manufacturers claim that a one-megapixel camera can produce photo-quality 5x7 prints and a two-megapixel camera can produce photo-quality 8x10 prints. Maybe they've been staring at video screens too long. Even without a magnifier, I can see staircasing and jaggies (the visible edges of pixels) in 4x6 prints made with one-megapixel cameras and in 8x10 prints made with two-megapixel cameras. Those artifacts nearly disappear in 3x5 (for one-megapixel) and 7x9 (for two-megapixel) prints. Sometimes a digital-camera manufacturer obscures the issue by using the term "photo realistic" instead of "photo quality." If your standard is film quality, be alert.

My biggest beef with digital cameras isn't their digital shortcomings, but rather their crappy features...

How many pixels does it take to match film? That's a matter of debate. Theoretically, the pixels should be at least as small as the silver-halide grains or dye clouds that compose a film image. That means tens of millions of pixels, even for grainy film. It's beyond current digital technology, which uses a CCD chip with tiny sensors to capture the light for each pixel. To match the quality of top-notch film such as Kodachrome 25, you might need 50 megapixels or more. A single image at that size (uncompressed) would require about 143MB of storage—much more memory than most digital cameras have today. And to process that image in a reasonable period of time, the camera would need a desktop-class microprocessor, which would make it an even more voracious battery-eater than today's digital cameras.

Luckily, the outlook isn't all that bad. The average snapshooter doesn't need Kodachrome quality. Few photos are enlarged beyond 8x10, so three megapixels are enough. Such cameras are widely available now, although they cost between $500 and $1,000, which isn't very competitive with film cameras.

Actually, my biggest beef with digital cameras isn't their digital shortcomings, but rather their crappy features when judged strictly as cameras. They seem to be designed by computer geeks, not camera engineers. Except for the high-end models based on 35mm SLR bodies, almost all digital cameras are ergonomic nightmares. They've got itty-bitty buttons, confusing controls, peephole viewfinders, fragile plastic shells, unreasonable amounts of shutter lag, and LCD screens inconveniently located where your thumb should grip the body. Even when shooting conditions are ideal, few digital cameras are the intuitive extension of your eyeballs that a good camera should be.

Still, based on the current pace of technology, I estimate that digital cameras will overtake film cameras for the average snapshooter in three to five years. It'll happen when three-megapixel cameras hit $200. For more serious shooters it'll take longer. I won't give up my trusty Leica until they pry it out of my cold, dead fingers. ✹

Random Thoughts

▶ Inkjet prints are approaching the quality of photographic prints—but as with digital cameras, they fall just short of the promised land. I've carefully compared inkjet output with my handmade darkroom prints, and I can still see digital artifacts such as printer dots. But the technology is improving so rapidly that I'll probably switch to a digital darkroom long before I switch to a digital camera.

▶ Not all digital snapshooters feel comfortable using image editors and inkjet printers. Web-based printing services such as Ofoto, Print@Kodak, and Shutterfly are a great alternative. Simply upload your image files and order prints on conventional photographic paper. Even on photo paper, though, the limits of pixel resolution still apply.

▶ Preserve your best digital photos by burning them on CDs. These are your digital "negatives" for future reprints. Remember, most inkjet prints fade away in a few years. Uncompressed JPEG files on CDs will be readable for decades to come.

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GAME THEORY

T. LIAM MCDONALD
is a veteran gamer and game writer. His reviews appear regularly in *PC Gamer* and other publications. Write him at **tmcdonald@maximumpc.com**.

Aside from its level design and music, I see little to justify the hosannas being sung about American McGee's *Alice*. There's no question that the scenery is beautiful, twisted, and a joy to behold. The gameplay, however, is a gumbo of bad imitation-Nintendo jumping puzzles and thoroughly unwieldy combat. I *like* third-person console jumping games. I even, sometimes, like third-person shooters. But while *Alice* works OK as a jumping game, it utterly bombs as a combat game.

The core problem with *Alice* is one of identity: It's designed like a jumping game, but the gameplay itself is heavily skewed towards combat. Combat rapidly becomes perfunctory, merely one more thing to get past. Instead of tension and suspense, the result is tedium and frustration. This is compounded by a maddeningly linear pace that reduces exploration to a bare minimum. *Alice* simply doesn't know what it wants to be, other than radical and transgressive, which pretty much means dressing the Alice character in S&M boots and adorning her jumper with symbols from the *Led Zeppelin 4* album cover. Yeah, so it's freaky and surreal. Big deal—it's *Alice in Wonderland*. The real effort would be in creating something based on Lewis Carroll's work that's *not* freaky and surreal. I am not amused.

***

I know I'm about to fly my geek flag by recommending *Bejeweled*, particularly after dissing the oh-so-edgy pseudo-art-house meringue that is *Alice*, but, fortunately, I could give a gnat's nuts. *Bejeweled* popped up on Microsoft's Zone (**http://zone.msn.com/bejeweled**) with the kind of pomp and fanfare usually reserved for a new David Cassidy CD. I would have completely missed it without the help of Jerry and Mike at Penny Arcade (**www.penny-arcade.com**), who always have a good eye for electronic crack.

Bejeweled is the absolute polar opposite of *Alice*. It is the Alpha to the other's Omega. The Yin to its Yang. The Sonny to its Cher. It's nothing more than a simple Java-based puzzle game in the *Puyo-Pop* or *Ballistic* mode, but it is fiendishly addictive. You click on jewels to reverse their position, creating jewel groups of three or more in order to clear the board.

This little item is the work of Jason Kapalka and his microcompany PopCap (**www.popcap.com**). The PopCap web site also has a healthy selection of other browser-based online puzzle games. Good puzzle games are actually quite tough to create, since they rely on balance and logic. PopCap has created about a half-dozen Java gems that make perfect light gaming in between other apps.

***

The people at Penny Arcade (is there anything they *can't* do?) also pointed the way to *Front Line Force*. I had initially glossed over *Front Line Force* as another attempt to ride the coattails of *Counter-Strike*.

Turns out that *Front Line Force* is a spiffy mod that blends the approaches of *TF Classic* and *Counter-Strike* and applies them to attacker/defender games. The locations, weapons, and situations are "real-world" style, but the damage modeling is more action-oriented, lacking the one-hit/one-kill approach that some people (read: *Quake* fans) find frustrating in counter-terrorism games. Players respawn after death, rather than sitting out the round. Each map contains multiple capture points that one team defends while the other attacks. Next round, the teams swap roles. It plays badly with just a few people, but larger games add another layer to the sometimes stale attack-game genre.

***

And speaking of mods, there's *Quake III Team Arena*. Ooops, wait, this actually costs $20. That makes it sort of a boxed mod, or, more accurately, a "boxed patch." The patch adds features the game should have had in the first place—and charges for them to boot. The team-play is actually pretty solid, though some maps are either too big or sprawling. To be honest, I have never encountered a mission pack for an id game that I really liked.

***

This month we received an item that earned coaster status almost before it was out of the box. That item is *Gameshark PC*. Console gamers have long known the joys of using cheats implemented through their Gameshark, because, short of entering Byzantine control combos, there was no other way to implement a cheat outside of a cheat cartridge. But PC gamers have this funny little thing attached to *their* game machines. They call it a "keyboard." This wonderful invention allows them to punch in cheat codes as they play the very game they want to cheat at—no external programs necessary.

So, right out of the box you have an item whose very existence is utterly irrelevant. *But wait!* It gets better! *Gameshark PC*, it turns out, doesn't actually—what do you call it?—*work*. The entire box is little more than an extravagant link to Gameshark's web site, where you can retrieve codes.

So, let's add it up: $20 + unnecessary idea + clumsy interface + doesn't work = save your receipt. ✹

What's Hot and What's Not

WHAT I *REALLY* THINK ABOUT *ALICE* AND OTHER NEW TITLES...

I know I'm about to fly my geek flag... but I could give a gnat's nuts.

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ULTIMATE MP3 SHOWDOWN

Looking to play your MP3s anywhere in the universe? We review 23 hardware players—some for your car, some for your living room, and some for your morning jog. Only the strongest shall survive.

by Will Smith, Kristen Salvatore, & Jon Phillips

You've ripped every CD you own and have hit up *Napster* for a kazillion megs worth of tunes—all of which are now stuck within the cramped confines of your PC. So how do you get your music off your computer and into the rest of your life? You get yourself an MP3 hardware player. A tidal wave of these swank devices is flooding the consumer electronics market, giving you the means to take your music just about anywhere.

For a while, it looked like MP3s would be a popular but passing fad. *Napster* seemed poised to go the way of the dodo when the RIAA stepped into court and threatened to shut down everyone's favorite peer-to-peer service. And when perennial metalheads Metallica threw down their own legal gauntlet in an effort to keep their songs from being traded via *Napster*, it became clear that it wasn't only record companies, but also some musicians who believed the MP3 phenomenon was stealing chickens from their financial coops. The digital music uprising, it seemed, would come to an end as quickly as it had started.

But after months of legal thrashing and Metallica bashing, Napster, Inc. and big-gun record label BMG agreed to team up in order to keep the service afloat—which, it turns out, was as good for Napster, Inc. as it was for the rest of us, since the fledgling company hadn't so much as a business plan lined up. Just what the Napster/BMG deal will mean to *Napster* users on a day-to-day basis is still unclear, but it's likely that you'll be asked to ante up a monthly fee for the privilege of trading tunes with folks across the country.

Doesn't do it for you? *Napster* certainly isn't the only game in town—other peer-to-peer clients, such as *Gnutella* and *CuteMX*, employ the same peer-to-peer sharing methodology, but don't run centralized servers the way *Napster* does. Suffering from an attack of conscience because you think your MP3 dabblings might be taking the food off Christina Aguilera's dinner table? Get over it. Record companies, including Sony and BMG, are tentatively but surely foraying into the MP3 sales arena, offering listeners the option of downloading songs for a fee instead of buying them on a CD. The upshot? MP3 isn't going anywhere, and though record companies have made a big deal about it, it's become a viable, marketed medium for music distribution.

And in Comes the Hardware...

That hardware manufacturers have responded like gangbusters means your listening options are multiplying by the minute. Just about every major consumer-electronics company has announced (or has already released) a slew of hardware designed to play MP3s wherever you want to hear them: while you're jogging, during your morning commute, or through your living-room stereo system. And, besides the big-name manufacturers, innumerable mom-and-pop operations are hawking MP3 players of all sorts. The choices are growing to an almost overwhelming level.

Which players are worth checking out? And which will allow you to play your music where and how you want it? What do you need to know before you buy? We've got the answers—and a few quick bits on MP3 software and some other digital music details you should know about.

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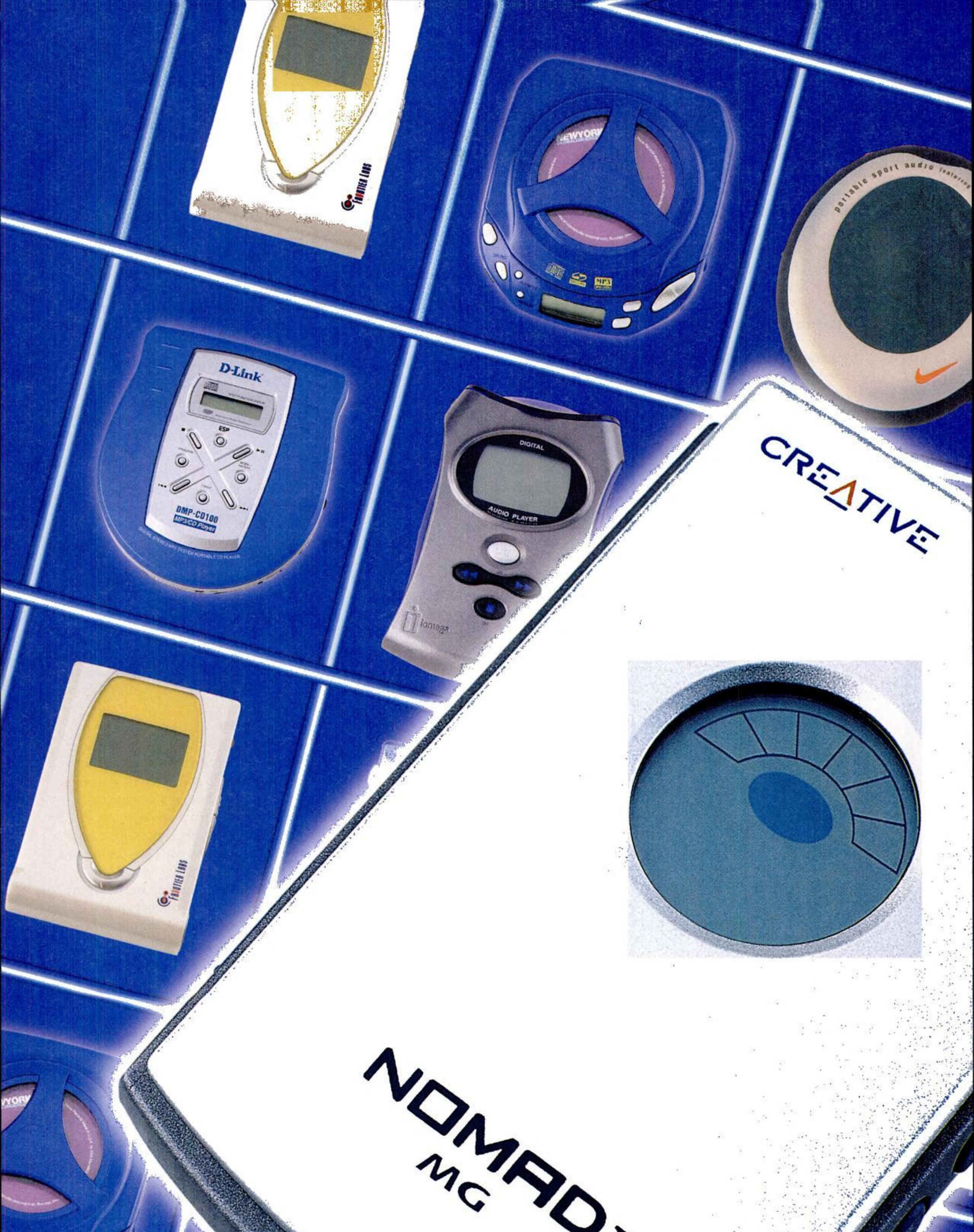

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ULTIMATE MP3 SHOWDOWN

Defining the Perfect MP3 Player

Our criteria es su criteria...

Do not—we repeat, do *not*—throw down your dough for the first MP3 player that comes along. It's worth your while to consider a few criteria before you pay for your player—and, lo and behold, they're the same criteria we considered when reviewing players for this feature.

Practical Application

There's a surfeit of players out there designed for an array of different uses. Which device you buy depends on where you intend to listen to your music. In general, MP3 players fall into five different categories. Are you:

▶ An exercise nut looking for a way to listen to tunes on the StairMaster? Try a small, solid-state player. **Pluses:** They're shock-proof and portable. **Minuses:** They're pretty expensive for something that holds just a few hours of music.

▶ Looking for a compact way to carry all your tunes, all the time? Check out a hard-drive jukebox. **Pluses:** They hold hundreds of hours of music and have line-out ports, so you can listen with headphones or plug the device into your home or car stereo. **Minuses:** You can't jog with one, and if the software interface is bunk, you're in trouble.

▶ Obsessed with your automobile? There are a variety of ways to get your MP3s into your car, from jerry-rigged quasi-solutions to full in-dash systems. **Pluses:** Thousands of songs at your fingertips mean you never have to listen to the radio again. **Minuses:** The technology is still somewhat immature.

▶ Dying to unchain your MP3s from the PC and start making use of that home stereo system you bought? Home stereo players are designed to get your MP3s pumping through your stereo speakers. **Pluses:** Listening to MP3s on big-ass home theater speakers is much more satisfying than listening on puny headphones. **Minuses:** Some of these players redefine the word "suck."

▶ A gadget freak? Companies are integrating MP3 players with a variety of other doodads, from cell phones to digital cameras. **Pluses:** It's a floor wax… no, it's an MP3 player. Wait, it's a floor wax *and* an MP3 player! **Minuses:** When your MP3 player's battery dies, so does your cell phone's.

Sound Quality

Sound quality is king, of course. After all, the main purpose of the hardware is to play your music. If a player doesn't accurately reproduce your MP3s, it's not much good as an MP3 player. For devices that include headphones, we tested sound quality with both the included headphones (they're generally pretty awful) and our set of reference Sennheiser HD-500 headphones. For solid-state players, we also tested loudness using the reference headphones. Two players in our car-players section included cheap, throwaway headphones, but these were not reviewed.

Memory

Pretty much across the board, more memory is better. But different MP3 players employ different memory schemes. It wouldn't make sense to saddle a small solid-state player designed to be used while exercising with a fat hard drive that's susceptible to crashes when jiggled.

Within the solid-state category, you'll find that different players use different sorts of media. Here's a quick rundown on what you're likely to encounter:

Smart Media – The most common digital player memory format can be found in sizes ranging from 8MB to 64MB. It's being replaced in some players by the MMC-format memory.

Compact Flash – More common in digital cameras. Sizes range from 8MB to 256MB. Many peripherals are designed for CF slots, including Iomega Click drives and IBM's 340MB MicroDrive.

MultiMediaCard – The MMC is used in the tiniest players and can be found in sizes ranging from 8MB to 64MB.

Zip Click – Basically a 40MB mini-hard drive, the Click disk is extremely sturdy.

Memory Stick – A proprietary Sony format that's been licensed by several other manufacturers for digital cameras, MP3 players, and robotic dogs. Memory Sticks range in size from 16MB to 64MB.

Our "minimum memory requirements" are 64MB onboard in a solid-state player and 4GB in a hard-drive-driven jukebox. Smaller capacities simply aren't acceptable.

Size

Some players are as small as a deck of cards, and some are the size of a pizza box. Again, form follows function, so expect to see larger players assigned to home and car use, and smaller players sold to joggers, with mid-sized MP3 jukeboxes and CD-based players falling somewhere in between.

Software and Connectivity

Almost all MP3 players connect to your PC somehow, since that's where your MP3 collection resides. Unless you're looking to kill a lot of time, don't settle for any connection interface slower than USB.

Nearly all players also employ some sort of software that a) allows you to organize your music, and b) acts as the interface between your PC and the player, governing the file-transfer process. In some cases, that software also determines how your player deals with security issues and SDMI compliancy (see sidebar on page 32). Simply put, if the software is finicky or difficult to use, it'll be a chore every time you try to move music on or off your MP3 player. And that ain't right.

Ease of Use

It's easy to get excited about a product that's laden with bells and whistles, but when it comes to MP3 players, you want something with bells and whistles that's easy to operate. If a player is equipped with an FM tuner, an address book, and a voice recorder, but MP3 playback seems like an afterthought, you need a better player. Don't let the added features dominate your purchasing decision. Instead, use them to differentiate between two otherwise equal players.

All the players we looked at were tested in real-world environments—that is, car players were tested in cars, solid-state players were tested while jogging, and home stereo players were tested in our living rooms.

For the solid-state player reviews, we tested six basic qualities of each player. Features such as sound quality and overall loudness were rated on a scale of 1 to 5 stars (5 is best, 1 is worst). These ratings were taken into consideration when we assigned the players *Maximum PC* verdicts, although some tests (e.g., sound quality), were weighted more heavily than others (e.g., headphone quality).

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Solid-State Players

If you're looking for an MP3 player you can run around with, you need a small solid-state player. All solid-state players share one thing in common: They have no moving parts, so your songs won't skip or warble even if you're listening while jumping on a mini-trampoline. But when it comes to features, usability, and sound output, some solid-state players are *definitely* better than others.

Creative Labs Nomad II MG

Sound quality	★★★★★
Software	★★★
Buttons	★★
Headphone quality	★★★
Loudness	★★★★
Screen	★★★★
Connection speed	USB
Memory size/type	64MB/SmartMedia
Supported codecs	WMA, MP3
Compatibility	
Extras	FM tuner, voice recorder
Price	$300

It sounds great, the FM tuner and voice recorder rock, and the cradle does double-duty as a recharger and file-transfer location. But funky button layout makes it almost impossible to use if it's in your pocket.

9 www.creativelabs.com
800.998.1000

Iomega HipZip

Sound quality	★★★★
Software	★★
Buttons	★★★★
Headphone quality	★★★★
Loudness	★★★★★
Screen	★★★
Connection speed	USB
Memory size/type	40MB/Click disk
Supported codecs	WMA, MP3
Compatibility	
Extras	additional Click disk
Price	$300

It isn't technically solid-state because it uses 40MB Click disks that spin like little hard drives. Still, we heard no skips, and it gets louder than any other player here—but a lower price would be nice.

8 www.iomega.com
888.516.8467

Nike psaPLay

Sound quality	★★★
Software	★★★★
Buttons	★★★★★
Headphone quality	★★★
Loudness	★★
Screen	★★
Connection speed	USB
Memory size/type	64MB/Flash MMC
Supported codecs	WMA, MP3
Compatibility	
Extras	cool remote, will attach to Nike clothing line
Price	$300

We liked its puck-shaped body, clip-on remote, and integrated connectors designed to work with a wide variety of Nike workout apparel. Unfortunately, it leaves a little to be desired in the sound department.

7 www.nike.com
408.588.8000

Compaq PAP

Sound quality	★★★
Software	★
Buttons	★
Headphone quality	★★★
Loudness	★★★
Screen	★★★
Connection speed	USB
Memory size/type	64MB/Flash MMC
Supported codecs	WMA, MP3, AAC
Compatibility	
Extras	n/a
Price	$250

It's the smallest player we took a look at—with the worst file-transfer software. If you can get past that annoyance (or just use *Windows Media Player* to do your transfers), the PAP is a decent little player.

7 www.compaq.com/ipaq
800.888.0220

RCA Lyra 2

Sound quality	★★★★
Software	★★★
Buttons	★★★
Headphone quality	★★★★
Loudness	★★★★
Screen	★★★
Connection speed	USB
Memory size/type	64MB/Compact Flash
Supported codecs	WMA, MP3, Real Audio G2
Compatibility	
Extras	FM tuner, car kit, USB CF reader, remote
Price	$350

One of two players we reviewed that uses Compact Flash memory, the Lyra has no internal memory, but includes a 64MB USB Compact Flash card.

8 www.rca.com
877.326.6601

Samsung Yepp

Sound quality	★★★★★
Software	★★★★
Buttons	★★
Headphone quality	★★★★★
Loudness	★★★
Screen	★★★★
Connection speed	USB
Memory size/type	64MB/SmartMedia
Supported codecs	MP3
Compatibility	
Extras	remote w/LCD
Price	$250

The Yepp delivers great sound quality in a small package, but we were mystified by the poor button layout on the player and its remote. Props to Samsung for not bothering to include its own crappy transfer software—the Yepp ships with *Real Jukebox* instead.

9 www.samsung.com
201.229.4000

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Solid-State Players (cont.)

Diamond Rio 800

Sound quality	★★★
Software	★★★½
Buttons	★★
Headphone quality	★★★★★
Loudness	★★
Screen	★★★½
Connection speed	USB
Memory size/type	64MB
Supported codecs	MP3
Compatibility	n/a
Extras	FM tuner, voice recorder
Price	$280

The Rio 800 is a better player than its older sibling, the Rio 600 (reviewed in October 2000), but not by much. The 800 includes 64MB of memory, but keeps the lame, proprietary backpack memory scheme. However, the *Rio Audio Manager* software is definitely the best vendor-provided software we've seen.

7 www.riohome.com
408.588.8000

Rave MP2200

Sound quality	★★★★
Software	★★★★½
Buttons	★★★★
Headphone quality	★★★
Loudness	★★★★
Screen	★★★★
Connection speed	USB
Memory size/type	64MB
Supported codecs	MP3
Compatibility	n/a
Extras	FM tuner, voice recorder
Price	$265

The Rave MP2200 is chock-full of interesting features, including an FM tuner and a voice recorder. It also has one of the better hardware interfaces we've seen and a great software bundle that includes clever extras such as an address book.

8 www.sensoryscience.com
480.998.3400

Frontier Labs NEX II

Sound quality	★★★★
Software	★★
Buttons	★
Headphone quality	★★
Loudness	★★★★
Screen	★★★★
Connection speed	USB
Memory size/type	0MB/Compact Flash
Supported codecs	WMA, MP3
Compatibility	▶
Extras	n/a
Price	$110

The NEX II is odd at best. Because the default unit ships without memory, you can equip it with as much Compact Flash memory as you'd like. The main problem is its screwy button layout; during testing, we just mashed different buttons 'til we heard the song we wanted.

5 www.frontierlabs.com
852.2527.3322 (Hong Kong)

Hard-Drive Players

Big storage in a small package

The truth of the matter is that there are only three hard-drive players currently available—and we've already reviewed two of them. For a quick look at what verdicts we gave the others, see the "MP3 Reviews Redux" sidebar on page 38.

Archos Jukebox

As far as your PC is concerned, the Archos Jukebox appears as a 6GB IDE hard drive, complete with drive-letter recognition. Loading it with files—MP3 or otherwise—is a no-muss, no-fuss matter of dragging and dropping. The Jukebox is amazingly compact—it's smaller than any other hard-drive player we've seen. Its brushed silver case is accented with blue rubber bumpers that protect its corners from bumps and bruises, and its 40-second buffer protects your tunes from skipping when jolts occur.

By rights, you should be able to use the Jukebox in your car or hook it up to external speakers via its line-out port. Unfortunately, we were never able to get the line-out port to function properly. We were also confounded by its USB cord, which has the same connectors at both ends. (We're going to use it to try to hook two computers together.)

Once your songs are on the Jukebox, navigating through them is tough. Ostensibly, you search through tunes and playlists in Browser mode, listen to music in Audio mode, and manage volume, play functions (shuffle, repeat, etc.), and EQ settings in Menu mode. But the process wasn't as simple as it sounds, in part because the backlit LCD displays letters so large it's hard to wade through all the information displayed on it at once. It does display ID3 tag information, but we still had tremendous troubles when trying to make our way to a particular song.

Overall, we liked the Jukebox because it made it easy to transfer tons of files from one computer to another. But for playback purposes, there are other, easier-to-use hard-drive players out there.

6 $350 | Archos
www.archos.com

Just what is SDMI?

SDMI—the Secure Digital Music Initiative—is a group comprised of more than 200 record companies, consumer-electronics companies, and other technology groups that pay a $20,000 annual fee for the privilege of membership. Though the RIAA was the "driving force" behind the group's genesis, SDMI operates independently. The group's stated goal is to "develop technical specifications for protected digital music distribution"—that is, to give consumers access to digital music while providing copyright protection to the artists who create the music. All artists, signed or unsigned, will be able to use the SDMI spec to protect their music, and choosing to distribute music in an SDMI-compliant format is entirely voluntary.

How SDMI protection will finally pan out is still unknown, but if the group has its way, SDMI-compliant devices won't play music that has been "illegally copied," i.e., music that isn't in an SDMI-compliant format. It's likely that SDMI-compliant files will include some sort of "key" indicating either that the file has been purchased or that it's good only for a limited number of uses.

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[actual size]

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Visit www.nomadworld.com

NOMAD® Jukebox is available in blue or silver.

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ULTIMATE MP3 SHOWDOWN

Car Players

How 9,000 songs fit in the trunk of a BMW M3

The MP3 phenomenon has yet to fully penetrate the car stereo frontier. Different types of devices will give you tunage in your cockpit, but each is fraught with its own idiosyncratic problems—small storage capacities, difficult interface navigation, and heinous unreliability are the worst roadblocks. But, hey, we're early adopters, and we want our MP3s everywhere—including on the highway—so we're taking a ride through the most mobile of MP3 arenas. The yellow flag of just-condensing vapor has been drawn, so we'll be driving with extreme consumer caution.

Neo-35

Of all the devices reviewed here, the Neo-35 is the only one that resembles a traditional car stereo component—it's meant to slide into your dash like a head unit or mount in your trunk like a CD changer. If you took the Neo-35 apart to see what makes it tick, you'd find a regular-old IDE hard drive that can hold thousands of MP3s and a tiny circuit board with a few chips on it—and that's about it. The PCB hosts MP3 decoding circuitry, as well as a rudimentary operating system that runs the unit's user interface. Together, the hard drive and circuit board comprise a bare-bones mini-computer that can send a high-fidelity audio signal to your existing in-dash stereo deck—when the unit works, that is. Unfortunately, the Neo-35 seldom brought a giddy smile to our faces during the time we had it. For the most part, the unit was a nightmare.

THE SPECS

NEO-35

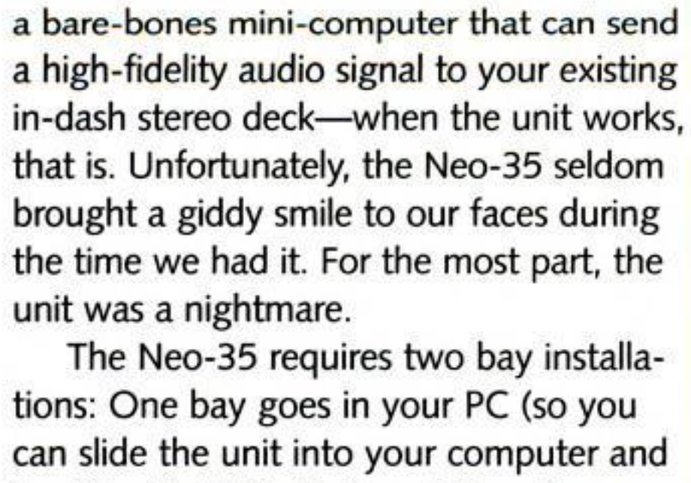
STORAGE TYPE
IDE hard drive

STORAGE AMOUNT
Determined by specific hard drive

FILE TRANSFER SPEED
Peaks at anywhere from 33 to 66MB/sec

FORMATS SUPPORTED
MP3

The Neo-35 requires two bay installations: One bay goes in your PC (so you can slide the unit into your computer and load it with MP3 files), and the other goes in your car. Unfortunately, getting the Neo into our test car, a 1997 BMW M3, was a bit of a pain. The unit was too deep to fit into the car's empty dash bay, so we had to mount it in the trunk instead. We also mounted an optional LCD control panel in the car's dash, snaked its cable through the innards of the car, and hooked it up to the main unit. Or at least we tried to—the Neo-35's supplied mounting bracket actually blocks the cable interface! In the end, we constructed a custom-mounting bracket and were finally on our way.



The optional panel for your dashboard offers better navigation than the base unit.

The Neo-35 offers everything you need in a car MP3 player—when it works like it's supposed to.

At first, the Neo worked well. Its sound quality was wonderful, and its folder navigation scheme was surprisingly intuitive, thanks in part to the optional control panel's button layout; the main unit's cramped button layout is incredibly frustrating. We were also pleased to discover that the Neo never experienced a song skip when the car's stiff, high-performance suspension traveled over San Francisco's notoriously pot-holed streets.

Sadly, when we fired up the car for a second test run, the unit's OS initialized when we turned the car's ignition key, but the hard drive wouldn't spin up. It finally came to life about 10 minutes into our test drive. After that, the Neo never came on immediately. Instead, drive spin-up took anywhere from 5 to 15 minutes—and, on one occasion, the unit reported a "drive error" and stopped working entirely.

Multi Technology Equipment, the Neo's manufacturer, suggested that the hard drive sent to us might have heavy power requirements and instructed us to experiment with a different drive. We wish the company had told us ahead of time that 5,400rpm Seagate and IBM drives are the Neo's preferred equipment (and we have no idea why it sent 7,200rpm Maxtor drives in each of our two review units). Regardless, we installed a 5,400rpm IBM drive in the second review unit and slid the Neo into our PC bay to load it with songs. We turned on the PC and were greeted with the smell of burning electronics! Lo and behold, this second Neo—which had worked fine the day before—was suddenly buggered. The Neo clearly powered up, but the LCD panel was dead, and the PC couldn't recognize the hard drive.

When the Neo-35 actually works, it's a marvel. It can house your entire MP3 collection (capacity is limited only by the size of your hard drive), traipse across drive directories with ease, and even execute playlist files. But because our experience with it was so riddled with headaches, we have to steer you away from it for now. The user's manual—rife with broken English and woefully lacking a slew of necessary instructions—is a complete joke. The optional dashboard panel offers better button layout than the head unit, but the buttons should be lighted for nighttime navigation, and the entire panel should be more solidly constructed (two of the buttons got stuck in a permanently "on" position after three days). Even early adopters should expect a certain amount of reliability. One Neo-35 fried inside our computer; the other worked only intermittently in our car. This is not the recipe for a wonderful MP3 experience.

NEO-35 **4**

$310 (price doesn't include hard drive; optional LCD panel costs another $70)
Multi Technology Equipment
www.ssiamerica.com | 732.560.1996

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ULTIMATE MP3 SHOWDOWN

Duo-Aria

Adopting the exact formfactor of a traditional audio cassette, the Duo-Aria can function as a stand-alone portable player or slip directly into your car's in-dash cassette deck. Using your deck's existing control buttons, you can play, rewind, fast-forward, and jump from MP3 file to MP3 file with ease. In fact, we were wholly impressed by the Aria's ability to offer MP3 playback through the ancient cassette deck interface. But while the device was reliable and easy to use, it suffered from some intrinsic flaws.

THE SPECS

DUO-ARIA

STORAGE TYPE
Onboard flash memory, MultiMediaCard support

STORAGE AMOUNT
32MB onboard, up to 96MB with MMC cards

FILE TRANSFER SPEED
1.5MB/sec (USB interface)

FORMATS SUPPORTED
MP3

THE SPECS

DMP-CD100

STORAGE TYPE
CD-R media (CD-RW not supported)

STORAGE AMOUNT
650MB

FILE TRANSFER SPEED
N/A

FORMATS SUPPORTED
MP3 as well as traditional audio CDs

First, the Duo-Aria is not the answer if you're looking to take a large MP3 library on the road. The unit contains just 32MB of onboard memory—that's enough for about six high-bit-rate songs. You can install a 32MB or 64MB MultiMediaCard, but you'll have to pay $75 or $130, respectively. And even then, you'll still top out at 96MB of storage capacity. Gah!

Second, compared to the Neo-35 (which hooks directly into the wiring of your car-stereo system), the Aria offers uninspiring sound with a noticeable amount of signal noise. Of course, some amount of signal degradation is to be expected because, no matter how you cut it, the Aria relies on your cassette deck to pick up an analog audio stream from the Aria's "tape head." That said, we extend kudos to Digisette for including an alignment control that lets you adjust the head for optimal sound quality, as well as compatibility with pesky cassette decks.

The Duo-Aria is sublime in its simplicity. Too bad it's capacity tops out at 96 relatively expensive megabytes.

Well-constructed in a sturdy aluminum case, the Duo-Aria is a nice stop-gap solution for folks who want MP3 playback on the road but don't want to ditch their old-school cassette deck. And unlike the CD/MP3 player reviewed below, the Aria won't clutter up the inside of your car. Nonetheless, its mediocre sound quality and bad "capacity-to-price ratio" deny it our highest praises. Oh well—at least it comes with an N-MH battery and two chargers (one for an electrical outlet, and one for your car's cigarette lighter).

DMP-CD100 MP3/CD Player

D-Link's CD100 looks and essentially functions like a portable audio CD player—except that it can play MP3 files off data CDs that you burn yourself. Some might argue that the CD100 doesn't belong in the "car stereo" section of this article, but the fact remains that many people are using portable MP3/CD players in their cars. Just hook a traditional cassette adapter into a player's line-out jack, plug the adapter into your car's cassette deck, and you're ready to mambo.

The beautiful side of this scheme is that 650MB CD media can hold about 150 high-bit-rate MP3 files—that's more than six times the capacity of a fully loaded Duo-Aria. The ugly side is that you'll have to find a comfy place for your CD player to sit. We placed the CD100 on the front passenger seat, and, on a few occasions, its line-out wire threatened to become tangled around the car's gearshift.

The CD100's folder navigation leaves much to be desired. While some players let you jump between folders with a single button-press, the CD100 ignores a CD's directory structure. Instead, it recognizes all the files on a CD as a single sequential list, so to jump from track 10 to track 132, you can press fast-forward 122 times or fiddle with a "digit" button that lets you define the specific track number. We don't recommend doing this while driving! Making matters worse, the CD100 can't display MP3 file names (which would aid in navigation), and its symmetrical button layout makes it difficult to navigate the interface without looking.

While the CD100's intrinsic sound quality was pleasant enough, we were disappointed to find that some MP3 files played with skips and pops despite the fact that we burned our CDs according to the manual's instructions and that these CDs played fine in our PC. On the plus side, the CD100 seems sturdily constructed, and we love the decisive click-action of its buttons. All in all, however, there are other portable MP3/CD players better suited for use in cars.

MP3/CD players are the answer for many drivers with cassette decks. Unfortunately, the CD100 is a poor example of the genre.

DUO-ARIA — **7**

$250 (price doesn't include MMC memory cards) | Digisette | www.digisette.com 973.455.7084

DMP-CD100 — **6**

$160 | D-Link | www.dlink.com 949.788.0805

Where Are the In-Dash Players?

Availability constraints prevented us from reviewing what might be the most elegant road-faring MP3 devices of all: in-dash head units that play MP3s from CD-R discs. Kenwood, Alpine, and Aiwa make (or have announced) such devices, and we intend to review them as soon as the vendors have units available and are willing to send them to us on our terms.

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Home Stereo Players

A mixed bag of MP3 merchandise

There's an entire class of hardware designed to let you play MP3s on your PC through your home stereo system. Some physically connect your PC to your stereo, and some integrate your MP3 collection with your stereo, taking your PC out of the equation altogether. For the record, all were tested for audio quality using a 1m RCA cable. Some of the devices offer digital S/PDIF connections, but we chose not to use them, since comparing one product's digital connection to another's analog connection hardly seems fair.

Turtle Beach Audiotron

Situate the Audiotron in your home stereo rack and you can play any MP3 stored on your networked PC through your stereo. Woo-hoo! And the

Audiotron even looks like a standard home stereo component—its matte black finish will blend in nicely with the rest of your stereo system. Using its remote and two-line LCD panel display that's easy to read in even the brightest of rooms, you can browse through playlists or create new ones.

THE SPECS

AUDIOTRON

FORMATS
WMA, MP3

STORAGE
None

CONNECTION TYPE
Ethernet, HomePNA

CONNECTION SPEED
10Mbps (Ethernet), 2Mbps (HomePNA)

The Audiotron's setup is painless: Just plug the unit into your network (10baseT or HomePNA), enable file-sharing for the directory on your PC that contains your music, and give the directory a name the device will recognize, such as Music or My Music. (Note: Your PC must be powered on for the Audiotron to work.) While the Audiotron's interface isn't the best we've seen, it's as good as can be expected on a two-line display.

The Audiotron's sound quality ain't too shabby either, though it didn't produce the best sound of the products reviewed in this section. However, true audiophiles will appreciate its Toslink digital optical output.

Our only major gripe with the unit is that it buffers every song it plays, so if you fast-forward through a song, there's a delay of up to two seconds while the next song loads. Turtle Beach told us that newer iterations of the firmware should alleviate the problem.

AudioRequest

The AudioRequest offers incredible functionality, but its features come at a cost. At $800, it's the most expensive device we reviewed. Its black case conceals a Celeron-powered PC complete with a CD-ROM drive and a 20GB hard drive. That's right—the AudioRequest can rip, encode, and store all your digital audio just like a standard PC and still fit nicely into your stereo system. Or, if you'd rather, you can grab your tunes from a computer on your home network.

You can interact with the AudioRequest via the backlit, four-line LCD on its front panel, or by connecting the unit to a TV or monitor and accessing its excellent GUI. The unit allows you to build your own playlists or select random songs, no matter what interface you choose to use.

We had few complaints with the AudioRequest's sound quality; we heard no errors, noise, or lag when switching tracks, and sound quality was great, without any artifacting.

Though we're impressed with its features, the AudioRequest left us chewing on one big question: If you already have a PC equipped with beaucoup storage, why would you spend $800 on a component that duplicates your PC's resources? Cool GUI and living-room-worthy formfactor aside, we just can't see spending $800 on this thing. Overall, it's the most fully featured home stereo MP3 player we reviewed and would be great for someone just getting into the digital music scene. But if you're already PC-equipped, buy a bigger hard drive and one of the other players.

THE SPECS

AUDIOREQUEST

FORMATS
MP3, WMA (via upgrade patch)

STORAGE
20GB

CONNECTION TYPE
Ethernet

CONNECTION SPEED
10Mbps (Ethernet)

Jensen Matrix

The Jensen Matrix wirelessly connects an audio source to an audio receiver—assuming the two are no more than 20 feet apart. Although Jensen claims this product will transmit a signal up to 150 feet and through walls, we couldn't get a clear signal even 50 feet from the base unit. When it did work, the

signal was disrupted when people moved around the room, resulting in loud, nasty pops and clicks. We implore you: Don't buy it.

THE SPECS

MATRIX

FORMATS
Anything that your computer can play

STORAGE
None

CONNECTION TYPE
Wireless - 900MHz

TURTLE BEACH AUDIOTRON — 9
$300 I www.turtlebeach.com
800.233.9377

AUDIOREQUEST — 8
$800 I wwww.request.com
800.236.0802

JENSEN MATRIX — 2
$100 I www.jensenwireless.com
800.732.6866

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ULTIMATE MP3 SHOWDOWN

Dell Digital Audio Receiver

Once in a while, we see a piece of hardware that actually makes us say, "Wow!" Enter the Dell Digital Audio Receiver. It serves a simple function and serves it well: Just plug it into your HomePNA or 10baseT network, install its software on your PC, and a database of all the tunes on your system gets fed to the receiver on the other end of the network. Plug a separate set of speakers into its amplified speaker ports or hook it up to your home stereo via RCA connectors, and voilà—MP3s in any room.

THE SPECS
DELL
FORMATS
MP3, WMA
STORAGE
None
CONNECTION TYPE
Ethernet, HomePNA
CONNECTION SPEED
10Mbps (Ethernet), 10Mbps (HomePNA)

THE SPECS
KIMA
FORMATS
Anything your computer can play
STORAGE
None
CONNECTION TYPE
Wireless – 900MHz

THE SPECS
STEREO LINK
FORMATS
Anything your computer can play
STORAGE
None
CONNECTION TYPE
USB
CONNECTION SPEED
12Mbps

The Digital Audio Receiver also gets top marks for its interface. Using a simple control knob, you can choose tunes based on any of the standard ID3 tag settings: Album, Artist, or Genre. And the display can be

customized to show different levels of information about your tunes.

Of course, all this convenience would be for naught if the thing sounded like crap. But the Digital Audio Receiver delivered sound that's considerably better than any of the other players we reviewed; playback was almost indistinguishable from the uncompressed original. Overall, it's a great home stereo/MP3 solution.

Kima

A ray of wireless light shone down upon us when we opened the Kima's box. Created by the oddly named akoo.com, the Kima was designed to do but one thing: send an audio stream from your PC to your home stereo from up to 1,000 feet away over the airwaves. We don't know about 1,000 feet, but it worked beautifully from 40 feet.

The Kima lacks management features that would allow you to change tracks

from the couch, which limits its usefulness. But it produced sound that rivaled that of the Dell Digital Audio Receiver.

Stereo-Link

The Stereo-Link takes an innovative approach to digital audio delivery, employing a really long USB cable and a long, shielded coaxial audio cable. Once connected to your PC, the Stereo-Link serves as a USB Audio device, which means any audio played over it incurs a CPU penalty, and any concurrent CPU activity can result in sound hiccups and other errors. The device's interface is convenient, in that you control it using whatever software you usually use for MP3 playback, and

the Stereo-Link works as advertised, but we think your money is better spent on either the Dell Digital Audio Receiver or the Turtle Beach Audiotron. They're a little more expensive, but much more functional overall.

DELL DIGITAL AUDIO RECEIVER 10
$300 | www.dell.com
800.999.9955

KIMA 6
$100 | www.akoo.com
888.566.2566

STEREO-LINK 6
$200 | www.stereo-link.com
617.995.3500

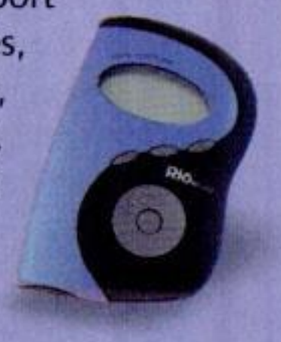
MP3 Reviews Redux

For comparison purposes, here's a brief recap of MP3 players that we've reviewed over the past six months.

Creative Nomad II

One-touch voice recording, built-in FM tuner, and crisp sound—we like, we like! No onboard memory and software that's rife with useless popup boxes—we don't like. Still, the Nomad II performs more than admirably and sure as heck knocks the block off the Rio 600, its closest competitor when we reviewed it. *Received an 8 verdict in June 2000.*

SONICblue (formerly S3) Rio 600



Its out-of-the-box support for MP3 and WMA files, svelte, grippable shape, customizable faceplate, and ability to play files back at ear-splitting volumes are all notable traits. Unfortunately, the Rio 600's meager 32MB of onboard memory, tough-to-operate controls, and abysmal software made it difficult for us to endorse this second-gen player from the company that once ruled the portable-MP3-player roost. *Received a 6 verdict in September 2000.*

Genica Tavaura/EasyBuy 2000 MPTrip

Though it gets props for being the first product of its kind—a CD player that plays both WAV files and MP3s—to hit the market, the Genica/EasyBuy (same product, two distributors) suffers from such first-gen jitters as chintzy construction and sound output that's sometimes inexplicably muffled. Plus, its lack of an LCD renders our ID3 tags useless. *Received a 6 verdict in December 2000.*

Pine D'Music MP3/CD Player

With a good-looking case, an LCD that

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Strange Brews

MP3 players get mixed in with other products

More and more companies are equipping their products with MP3-playing capabilities—whether it makes sense or not.

Good Technology SoundsGood

Sound quality	★★★
Software	★★★★
Buttons	★★
Headphone quality	★★★
Loudness	★★★★
Screen	★★★★★
Connection speed	USB
Memory size/type	64MB
Supported codecs	MP3
Compatibility	
Extras	Handspring Springboard module
Price	$250

MP3s on your Handspring PDA—simply awesome. It's slim and easy to use, and the sound quality is more than tolerable. We just wish the memory was expandable.

8 www.good.com
866.723.4663

Innogear MiniJam

Sound quality	★★
Software	★★★
Buttons	★★★
Headphone quality	★★★★
Loudness	★★★★
Screen	★★★
Connection speed	USB
Memory size/type	64MB/Flash MMC
Supported codecs	MP3
Compatibility	
Extras	Handspring Springboard module
Price	$260

The MiniJam holds MP3s, ebooks, and images. We like the versatility. Unfortunately, its sound quality left something to be desired. It's not perfect yet, but we're keeping our eye on it.

7 www.innogear.com
877.711.6778

Samsung Uproar

Sound quality	★★★★
Software	★★★
Buttons	★★★★
Headphone quality	★★★
Loudness	★★★★
Screen	★★★
Connection speed	USB (proprietary cable)
Memory size/type	32MB
Supported codecs	MP3
Compatibility	
Extras	remote, voice recorder, web browser
Price	$400

Hey, you got your MP3s on my cell phone. And you got your cell phone mixed with my MP3s! Easy to use and high on the Cool Gadget list—if only it had more memory.

9 www.samsung.com
201.229.4000

Fuji FinePix40i

Sound quality	n/a
Software	★★
Buttons	★★★
Headphone quality	n/a
Loudness	n/a
Screen	★★
Connection speed	USB
Memory size/type	16MB SmartMedia
Supported codecs	MP3
Compatibility	
Extras	n/a
Price	$600

MP3 in your digital camera—interesting concept. Too bad memory problems kept us from getting it to work properly. And there's something to be said about a gadget that does just one thing well...

5 www.fujifilm.com
800.659.3854

displays your MP3s' ID3 tag information, and easy-to-navigate controls, the D'Music is the best of the first MP3/CD players to cross our test benches. Its sound is ear-bleeding loud, but lacks warmth. Well-implemented equalizer settings help to some degree, but we'd be happier if the highs had more pop and the lows had more thump. *Received an 8 verdict in December 2000.*

Philips eXpanium

In the "good-lookin' but there ain't much under the hood" category, the eXpanium is the worst of the first bunch of MP3/CD players we checked out. In spite of its excellent playlist and navigation capabilities, we're completely put off by its awful sound output and lack of an LCD. Its shock protection works well, though... *Received a 5 verdict in December 2000.*

Neo 25

An IDE hard drive in disguise, the Neo 25 can store 12GB worth of MP3s—or any other sort of file, for that matter. We loved its drive-letter recognition, speedy transfer rates, and quick boot times, but wished for less-wiggly navigation buttons, a less-confusing LCD, and more EQ options. *Received a 7 verdict in February 2001.*

Creative Nomad Jukebox

Great Scott! 6GB of MP3s in one place, plus a veritable buffet of audio options ranging from highly customizable EQ settings to time-stretching, which allows you to speed up or slow down a song without changing its pitch. When we first checked out the Jukebox, we slammed its "SDMI-compliant software" that kept you from loading files onto the player from one computer and unloading them onto another computer. Creative has informed us that a firmware upgrade disables that feature. Upload and download at will! *Received an 8 verdict in February 2001.*

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ULTIMATE MP3 SHOWDOWN

MP3 Software

We try to break the most popular MP3 software so you don't have to...

What a difference a year makes! When we took our first look at MP3 software in February 2000, most of the apps we saw were immature at best. Since then, Microsoft has entered the digital audio race in earnest with *Windows Media Player 7*, and the two major players in this arena—*MusicMatch Jukebox* and *Real Jukebox*—have cleaned up their acts considerably. Below, we take another look at all three of these "all-in-one" digital audio utilities.

We aren't giving *Winamp*, *Sonique*, or other software MP3 players full reviews this go-round, but we did do a little blind testing. Both *Winamp* and *Sonique* produce decent sound, but our testers determined that *Sonique* delivered much crisper highs than those anted up by *Winamp*.

Real Jukebox Plus

The folks at Real have spent the last year hard at work on *Jukebox*, and the improvements really show. This year's *Real Jukebox* is much more stable and brings several interesting features to the table, including the most configurable database we've seen.

Real Jukebox's raison d'être is to manage your digital music collection. All-in-one utilities should allow you to easily add and remove music from your collection, as well as generate playlists from a database containing information about all of the music on your system. This database is *Real Jukebox*'s most powerful feature. Once you specify your MP3 folder, *Real Jukebox* can be set to constantly monitor that directory for additions, deletions, and changes. It also keeps track of the CDs you've ripped, so you don't accidentally rip the same disc twice. You can even use the program to burn an audio CD from MP3s, though you'll need to pay $20 for the full version of the plug-in that allows you to do so.

Thankfully, *Real Jukebox* no longer hijacks your file associations, but it does still steal the association for CD Audio. This brings us to our most serious gripe. The setup wizard is confusing and intentionally misleading. During the installation process, users are encouraged to enable *Real Jukebox*'s "secure music" features. But if you do, none of the music you rip using *Real Jukebox* will play on any other computers. This keeps you from playing your tunes at work and home—a practice that, by the way, is legal. It's possible to bypass the security by sharing the same encryption key at home and at work, but that's a pain in the arse that we don't need.

Still, *Real Jukebox* has seen vast improvements since its last iteration. We're impressed.

MusicMatch Jukebox

Last year, we couldn't say enough good things about *MusicMatch Jukebox*. Unfortunately, the defending champion all-in-one utility was hobbled this time by stability problems. But despite the annoyance of having to continually restart the program, *MusicMatch Jukebox* did the business of managing our music.

The centerpiece of *MusicMatch Jukebox* is still its database, though we'd like to see some of the more advanced features that *Real Jukebox* includes, such as a music directory that monitors changes. One feature *MusicMatch* does offer that *Real Jukebox* doesn't is the ability to burn CDs containing either raw MP3s or CD audio at your drive's max speed. The caveat is that CD-burning in *MusicMatch* is limited to a short list of supported drives—if your drive isn't on that list, you may be better off going with *Real Jukebox* or using your default CD-burning software.

MusicMatch's encoder truly shines, giving users access to almost every option available during the ripping/encoding process. In addition to the standard bit rate/quality selections, you can adjust everything from the extraction type to the amount of stereo processing you want done.

With a few new features, *MusicMatch Jukebox* would be the perfect choice for all your MP3-related needs. But for now, we can recommend it only for the audiophile who wants to control every aspect of MP3 ripping and encoding.

Windows Media Player 7

When Microsoft enters a market, people take note. When *Windows Media Player 7* was released, people took note, and then giggled uncontrollably.

Windows Media Player 7 simply doesn't encode to the MP3 format. It will play MP3s and add them to its music library, but in terms of ripping, your only choice is the WMA format. When you factor in its horrific interface, poor performance, and lack of a playlist generator, *Windows Media Player 7* is barely worth mentioning... barely.

REAL JUKEBOX PLUS — 8
$30 | www.realjukebox.com
888.768.3248

MUSICMATCH JUKEBOX — 7
$30 | www.musicmatch.com
800.347.2566

WINDOWS MEDIA PLAYER 7 — 2
Free | www.windowsmedia.com

A spec for CD players

The new CDA spec controls digital audio playback

While there's nothing like digital audio to encourage development of new specifications galore, the CDA spec is one that we're really looking forward to seeing. (For more details on other audio compression specs and how they work, check out this month's White Paper on page 65.)

The Optical Storage Technology Association, which defines specs for all types of optical media, has started development on the CDA format. Like the Redbook CD-A format that governs how data is stored on a normal audio CD, the CDA format will provide a standard for storing digital audio such as MP3 and WMA on CDs designed to be played on portable devices.

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intel inside pentium 4

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GIANTS™

CITIZEN KABUTO

LUMBERING MOUNTAIN

KABUTO:

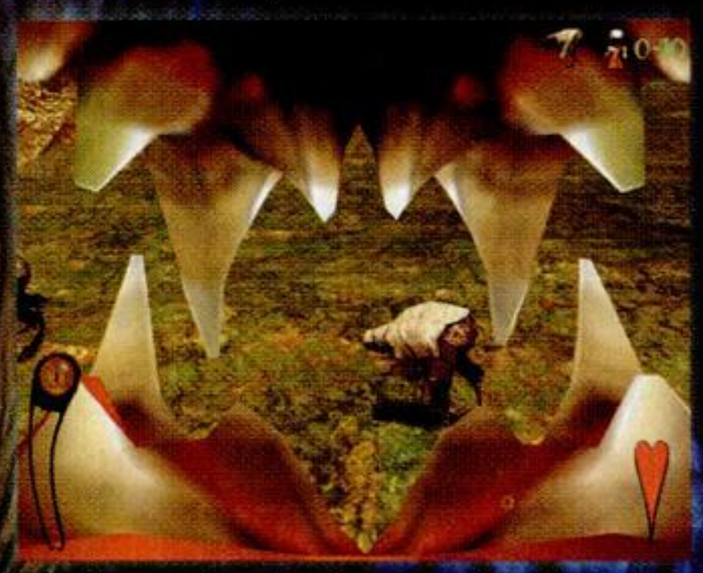
Summoned by the Sea Reapers to defend the island, this giant ferocious beast is simply too brutal to exist with any other creature. Ten times the height of anything on the island, Kabuto is a uniquely nasty creature. Pray he swallows you whole rather than making a fashion statement by wearing a struggling you on his razor sharp spikes, keeping his hands free to crush the rest of your team with an elbow smash. You'll need every ounce of firepower to take down this fang-filled eating machine.

"He can't wait to eat...er...meet you!"

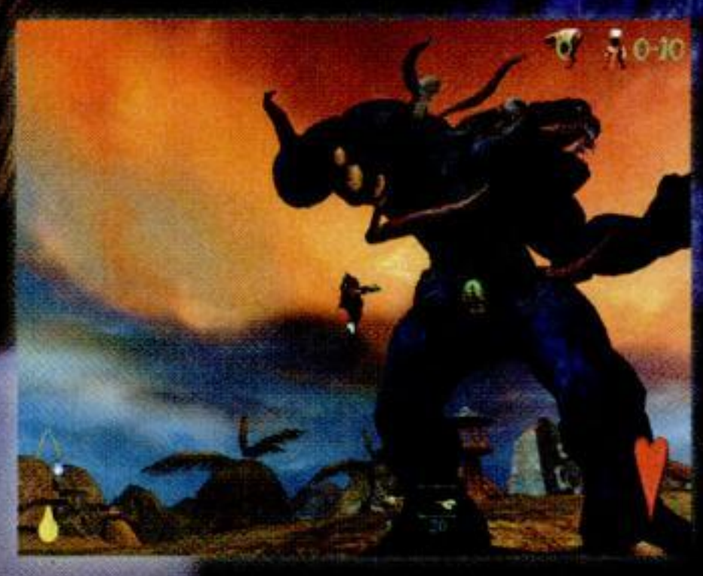
"With a complex story and beautifully crafted 3-D graphics, the single-player game offers the kind of depth that's been sorely lacking in action games lately." -- Rolling Stone

OF PAIN

Eat, crush, and destroy anything in your path as Kabuto.



Through the fangs of Kabuto is the only way off the island.



Defeat this massive monster or end up an appetizer.

MATURE M CONTENT RATED BY ESRB

Animated Blood and Gore

Animated Violence

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nVIDIA graphics

www.interplay.com

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Fancy yourself a power user? You're not unless you're experimenting with your hardware *and* your operating system. Alternative OSes are the realm of true PC tweakers...

So, you think you're hardcore, do you? Able to build dual-processor machines and fine-tune RAID arrays in your sleep? You're only halfway there, buster—true power users muck around with their rig's hardware *and* operating system. After all, you can't fully unleash the power of your hardware without the right OS. Think Windows is giving you that kind of power? Think again. It's time to check out your operating-system options.

Windows does some things well, but it's far from perfect. There's no magic OS out there that can completely kick Windows' backside, but some of the alternatives definitely outperform—and outstyle—Windows when it comes to certain tasks. If you're looking to set up a super-secure server, build a better A/V station, or play a CD backward (you can do it with BeOS), Windows blows.

You may not want to completely replace Windows on your machine, but know that spending some serious time getting to know the alternatives actually helps to light a fire under the Redmond guys' collective rear. With thousands of programs built to take advantage of alternative operating systems' ability to "do things differently than Windows," Microsoft is forced to create better products. As far as we're concerned, Windows 2000 wouldn't be half the OS it is today if it weren't for Linux, FreeBSD, BeOS, and MacOS.

We pulled together the alternative OSes we think are most worth your time. On the following pages, you'll find the lowdown on each, including information on where to get ahold of them. We also highlighted some terms that might need explaining—you'll find a glossary on page 48. Go ahead—get hardcore.

—Scott Tarr

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Linux

Where did it come from?
The brainchild of then-college student Linus Torvalds, Linux was born in 1991 as a result of Torvalds' distaste for DOS and Windows, and his inability to afford UNIX.

In 1994, Torvalds released Linux to the masses as an open-source operating system; all of the OS's source code can be openly viewed and altered. Over time, different groups have created different "distributions" of the OS, adding features that vary from one version to another. The result is that a variety of Linux versions are currently available.

Where can you get it?
Though Linux is technically available for free, if you're looking for tech support, documentation, and applications specifically designed to work with Linux, plunk down some dough for a packaged version. Red Hat (**www.redhat.org**), Debian (**www.debian.org**), and Mandrake (**www.linux-mandrake.com/en**) are all popular options.

What's so good about it?
Because Linux is an open-source OS, virtually every aspect of it is customizable—a veritable dream for tweakers. But it's Linux's reputation as a server-friendly operating system that's won it so many fans. Looking to run a proxy server, an FTP server, and a file server simultaneously on the same machine? Windows ain't gonna do it, but Linux will tackle the task with ease. And since Linux doesn't require massive PC firepower, it's very friendly, even on rusty-crusty old machines. Turn that old 486 into your OS-tweaking box and be the envy of all your geek friends!

Because it's becoming so popular, more and more Linux-compatible software is available, including a healthy helping of games (check out **www.lokigames.com** for a look). That popularity also gets you the benefit of tech support—and lots of it. Linux users are among the most active folks on Usenet, and if you purchased Linux through one of the many formal distribution channels out there, you have access to the same level of tech support you'd get for any boxed software. If you're new to OS tweaking, that's a nice safety net.

What's not so good about it?
Linux's command-line interface (CLI) can make users feel as though they've tread into the dreaded DOS realm. Until you learn enough commands to bend Linux to your will, many facets of this OS can be daunting.

Also, a lack of standardization among distributions can make for trouble when choosing applications—some apps are optimized to work with one distribution but not another. And though more and more popular games are being ported to Linux, 3D acceleration needs a major shot in the arm before the hottest games will be as enjoyable in a Linux environment as they are in Windows.

What do we think?
It's almost unfair at this point to call Linux an "alternative OS." In the past few years, it's gained a sizeable, diehard following. And it's common to see Linux-run servers at places such as Amazon.com. But in terms of feeding your tweaking jones, Linux's close-to-limitless configurability is top-notch. And it's kinda nice to know that there's tech support available if you need it.

FreeBSD

Where did it come from?
In 1993, Nate Williams, Rod Grimes, and Jordan K. Hubbard set out to fix the neglected kernel of 386BSD. They wound up with a new OS altogether. Though FreeBSD is an open-source OS, the organization that owns it (BSDI) controls, maintains, and releases the official versions for free (BSDI releases the OS, but doesn't sell it). At any given time, BSDI offers three versions of FreeBSD: an official "release" version on CD (e.g., version 5), a "stable" version comprised of mostly time-tested features but with some new goodies thrown in (e.g., version 4.2), and a "current" version that boasts features BSDI has recently added but hasn't completely tested (e.g., 6x, a beta version).

Where can you get it?
FreeBSD can be downloaded at **www.freebsd.org** or any of its mirror sites. It's also distributed in CD-ROM form, often bundled with books detailing the intricacies of the operating system. Your local Barnes & Noble should be able to hook you up.

What's so good about it?
Essentially UNIX for the x86 platform, FreeBSD offers merged-virtual memory and a filesystem buffer cache, allowing users to fine-tune the amount of memory allocated to programs. That's useful if you're running a server that requires almost no downtime, such as a network router. Or a mainframe in a hospital. Or Yahoo.

FreeBSD is similar to Linux in many respects: It offers multiple desktops and multiprocessor support, and the same desktop environments run on both platforms. FreeBSD uses the X desktop environment, which means a FreeBSD machine can run Linux programs written for X.

Unlike Linux, with its many and varied distributions, FreeBSD is standardized—there's just one distribution out there, so any program written to run on FreeBSD will work on all FreeBSD boxes. And perhaps best of all, FreeBSD, like Linux, can bring new life to a PC that you'd previously written off as ancient. Dust off that old 386!

What's not so good about it?
Like most of the operating systems we looked at, there's a dearth of FreeBSD-compatible software. FreeBSD can run many Linux programs, which opens up some options, but compared to the number of Windows-compatible applications, the pickings are rather slim.

Getting into the guts of FreeBSD requires some knowledge of the command-line interface—if you're looking for Windows-esque hand-holding, you're going to be disappointed. To really unleash the power of this operating system, be prepared to spend some quality time at the command line.

Terms high-lighted in red are explained on page 48.

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Linux isn't just for geeks into networking; it's a full-fledged OS with other capabilities, too.

FreeBSD has all the networking options of Linux, and then some.

What do we think?
FreeBSD, as a rule, is easier to set up than most Linux distributions. And since it employs the X11 desktop, it can run multiple desktop environments on the same machine. FreeBSD provides a good alternative-networking environment, but user support is more limited than that provided for Linux users—the FreeBSD user base is smaller. Still, FreeBSD is among the most stable OSes we've seen, and, hey, it's free!

BeOS

Where did it come from?
Late in 1990, Jean-Louis Gaseé, then-president of Apple's product division, began work on creating an inexpensive, media-savvy, multiprocessor computer—essentially the Amiga done right. Thus, the BeBox and Be, Inc. were born.

The BeBox ran Be, an entirely new OS that included multiprocessor support, multi-threading, and a 64-bit journaled filesystem. Be ran on Apple's early Power PC machines, but was ousted in favor of NeXT. Eventually, the fine folks at Be, Inc. tweaked BeOS so that it could run on x86 machines. Since then, four versions of BeOS have been released for use on x86 machines. The latest is available in two versions: the full-featured Pro Edition, and the free, stripped-down Personal Edition, in which some features, such as CD-R apps, are taken out. The Personal Edition is designed to work inside Windows, so there's no need to create a separate partition for it if you're installing it on a Windows machine.

Where can you get it?
BeOS 5.0 Pro Edition can be purchased at Fry's Superstores, from online vendors, or through Be's distributor, Gobe software (**www.gobe.com**), for $70. The free BeOS 5.0 Personal Edition can be downloaded at **www.be.com/products/freebeos/**.

What's so good about it?
BeOS is a multi-threaded OS, which means multiple apps can access the CPU at once—unlike a single-threaded OS, such as Windows 3.1, in which only one app can access the CPU at once. Because of this, BeOS is an especially "brisk" OS—you'll never see the equivalent of the Windows hourglass.

A/V junkies are especially fond of BeOS. Because the OS gives higher CPU priority to A/V files than most other OSes do, it boasts exceptional audio and video playback capabilities, such as the ability to run 10 to 20 A/V files simultaneously—all without skipping a beat.

BeOS's database-like filesystem, dynamically loadable device drivers, and pervasive multi-threading and pre-emptive multitasking ensure that the ball in BeOS never stops bouncing—the OS rarely crashes. Did we mention that it's POSIX-compliant, and that *NIX programs are easily ported over to Be? And that the 64-bit, journaled filesystem keeps data integrity at a maximum and addresses incredibly large files with ease?

What's not so good about it?
As an OS, Be's biggest drawback is its poor networking capabilities. It seems that when all that priority was thrust toward making BeOS an excellent A/V system, a few other features fell by the wayside. BeOS's networking stack particularly suffered.

Upon the release of version 5 of the OS, Be, Inc. announced it was shifting focus to the emerging Internet Appliance market and would therefore no longer devote resources to future BeOS support. Because of this, BeOS device drivers are maintained by the rather small BeOS community and vendors kind enough to provide that support, such as nVidia and ATI. Of course, tech support is also limited.

THE AMIGA OS

In the early 1990s, Amiga was king of graphics computers; even Apple couldn't compare to the might of Amiga, which could crunch numbers at an outstandingly fast speed (for that era, anyway). But alas, Amiga died off in the mid-1990s. It was eventually purchased by Gateway, which sold it to Amino in early 2000. Since then, Amino—after changing its name to Amiga—has been hard at work on resuscitating the Amiga of yesteryear. In the meantime, the company recently released an updated version of the Classic Amiga OS.

Amiga has designed a new Amiga OS specification, called Zico, which calls for an Amiga-friendly processor (Power PC, x86, ARM, SH4, and SH5 procs), Creative's EMU10K1 audio chip, FireWire, Ethernet, and an unnamed future Matrox video chip. The entire specification will create the Amiga Digital Environment, which should be released sometime during 2001. If all goes according to plan, the Amiga DE will be installed in such devices as PDAs, desktop PCs, and workstations—and, hopefully for graphics folks, it will pick up where the old Amiga left off.

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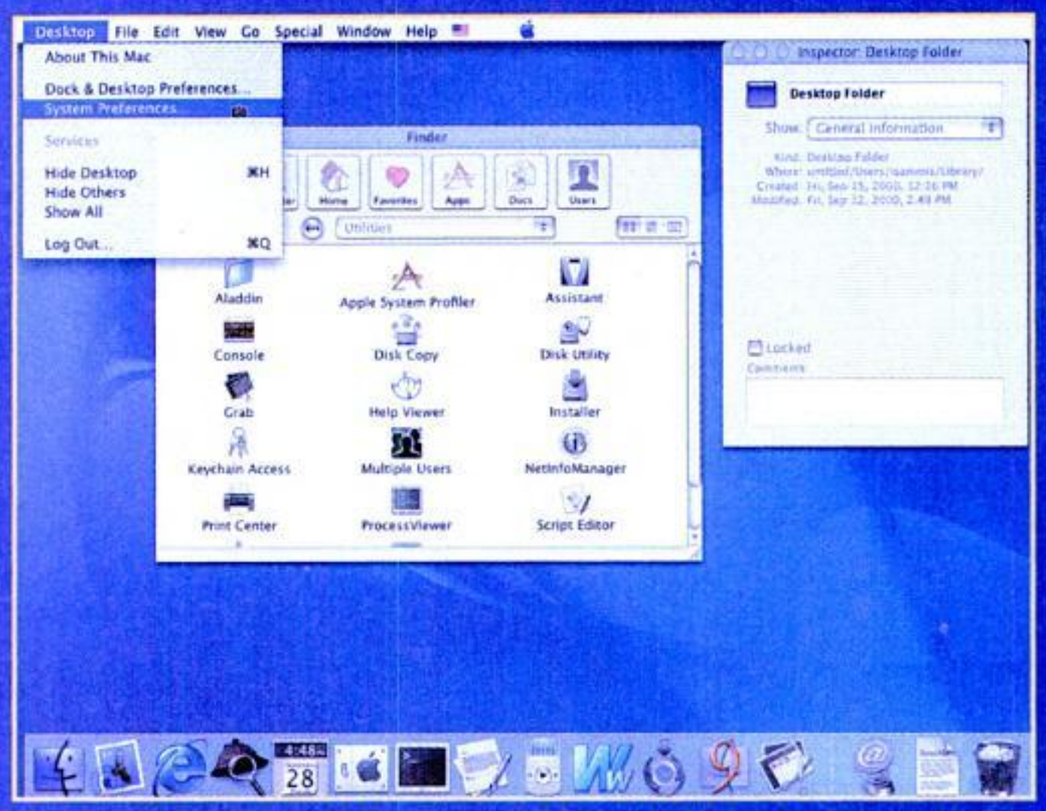
The audio/video capabilities of BeOS are unsurpassed by any OS out there today.



Mixing the networking capacity of UNIX with a pretty interface, Mac OS X has the best of both worlds.

What do we think?
It's a shame that Be, Inc. stopped major development of the BeOS. The operating system had a good chance of bridging the gap between the server-oriented Linux crowd and the ease-of-use Windows drones—it's an alternative OS so easy to install and use, you're looking at 10 minutes between beginning the install and surfing the net. And A/V-philes *must* investigate this OS.

What's so good about it?
Mixing a polished GUI à la Windows 2000 and a command-line interface à la Linux, OS X delivers the best of both worlds. Whereas BeOs couldn't bridge the gap between Linux's networking and Window's ease of use, Mac OS X does. It ships with Apache—which sets the standard when it comes to server apps—so it has better networking capabilities than Mac OS 9 and its emptive multi-tasking, and symmetrical multi-processing. And Apple created an entirely new interface, called Aqua, which sits atop the Mach kernel, shielding users from the command-line interface of a UNIX shell.

What's not so good about it?
OS X will only run on G3 and higher systems with 128MB of RAM and 1GB of hard drive space. And the stock Aqua interface is so littered with fruity colors and translucent buttons, it looks like an iMac exploded on the screen. Luckily, Aqua can be replaced rather easily.

The platform still lacks a good, low-latency sound interface, and because of the lethargic state of 3D acceleration on the Mac platform, gaming is on the—shall we say—wimpy side right now.

What do we think?
Game developers such as id Software are moving toward OS X, and *Quake III* has already been ported. High-end software developers including Alias|Wavefront are moving toward it as well. All of this seems to indicate that Apple will finally have an OS to be reckoned with. Still, Mac gamers should thank the computing gods that Apple finally decided to ship hardware with nVidia's GeForce2, rather than ATI's Rage128 graphics cards.

Mac OS X

Where did it come from?
When Steve Jobs returned to Apple in 1997, he brought with him the basis for OS X in the form of the OpenStep operating system. OpenStep, the OS that ran on the NeXT Cube, was the foundation of Apple's Rhapsody OS—which never made it out of Apple's Cupertino facility. After four years of development, Apple was left with OS X: a prettified operating system grafted onto the underpinnings of OpenStep/Rhapsody.

Mac OS X combines a modern UNIX-like core with the higher-level interface MacOS users are used to. Only a beta of OS X is currently available, and at this year's MacWorld trade show in San Francisco, Apple spokespeople made it clear that the final shipping version of OS X would look different than the beta.

Where can you get it?
Apple plans to ship OS X on March 24, 2001, with a suggested retail price of $129. Check **www.apple.com/macosx/** for more details.

What's up with emulators?

Though dual-boot managers make it easier to load two OSes on one machine and boot one or the other, some folks aren't interested in rebooting every time they want to switch between OSes. Emulators operate within one operating system and simulate a different operating system. Most are actually software layers that "sit" between the hardware and the OS and manage all the hardware resources in a virtual mode.

There are many emulators available. One of the most popular, WINE (**www.winehq.com**), allows most Windows programs to work in Linux and FreeBSD. WINE doesn't even require the use of Windows—it just runs Windows-based programs under a different operating system. Bochs (**www.bochs.com**) is another emulator that works with Linux and BeOS.

Even Windows has an emulator; SoftMac (**www.emulators.com**) allows Mac OS apps to work in Windows. Mac OS has Virtual PC, so you can run Windows apps on the Mac OS.

Emulation isn't the best way to get work done—your app will almost always run better in its native environment. It's a helluva lot easier, though, than rebooting every 10 minutes to run an app you want in its native world.

QNX

Where did it come from?
QNX was designed to work with x86 architecture and was the first OS to support

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Although QNX started in the embedded world, it's small, sleek and good-looking.

protected memory allocation mode. And because QNX is POSIX-compliant, it can work alongside UNIX-based OSes. It's also a realtime OS, meaning it's very predictable with fast response times that you just don't find in a general-purpose OS.

After QNX released the Neutrino kernel in 1996, the OS became available to the PPC, MIPS, ARM, and SH4 platforms. Now, virtually anything with a processor—including PDAs and mobile phones—is able to run QNX natively. Neutrino also added such features as the ability to customize the OS on the fly—even while in use—without downtime. All this, and it's small enough to fit on a 1.44MB floppy.

Where can you get it?

QNX can be downloaded for free at **get.qnx.com** (or swiped off this month's Maximum CD). If you'd rather have the OS on its own CD, it'll set you back $30.

What's so good about it?

For such an incredibly small OS, QNX is amazingly robust—this tiny OS can run *Quake III*, *RealPlayer*, and Flash. It's also highly reliable, has massive scalability, and offers superior memory protection—it can recover from software faults, even in drivers and other critical pieces of code, without rebooting. That's a godsend in embedded environments with critical missions.

Because QNX is a realtime OS, drivers, APIs, and modules all sit outside the OS's kernel—unlike Windows and Linux. If a QNX module acts up, the OS itself won't crash. In other words, QNX is incredibly reliable. It can also be equipped with dynamically loaded modules. Just pop in the module of your choice—be it a network manager or a different TCP/IP manager—and you're set. No reboot necessary. Don't like it? Uninstall it—it's that simple.

What's not so good about it?

Unlike every other OS described here, QNX has absolutely no Microsoft *Office* support—not even for *Word*. If you've decided to set up a dual-boot deal, you won't be able to transfer files between QNX and Windows.

In addition, early versions of QNX can't be installed onto a SCSI drive or a drive with NTFS (Windows 2000).

What do we think?

If you've tried Linux, Solaris, BeOS, and FreeBSD and found yourself wanting, QNX may be the right alternative OS for you. It's small, it's reliable, and it can be configured on the fly. Its limited software support and lack of Windows-app emulators mean it probably won't become your OS of choice, but it'll definitely feed your OS-tweaking jones. ✸

What happened to OS/2 and OpenDOS?

IBM's OS/2 Warp was supposed to challenge Microsoft's Windows 95. Instead, it ended up being used primarily in banks and ATMs. OS/2 had everything going for it; Windows compatibility and superior multitasking meant that OS/2 actually ran Windows apps better than Windows. So why didn't OS/2 catch on with The People? OS/2 couldn't run 32-bit Windows apps and thus died a premature death in the consumer market. Eventually, IBM retreated from the consumer market with its tail between its legs.

OpenDOS is actually still around—it's just taken its maiden name back. OpenDOS was originally known as DR-DOS, until Caldera purchased it from Novell in 1996 and marketed it as OpenDOS. But Caldera has since split itself into two companies. One kept the Caldera name and focuses on full-fledged Linux products, while the other, dubbed Lineo, focuses on embedded Linux products. OpenDOS is once again known as DR-DOS. It's available for free from Lineo at **www.drdos.org**.

GLOSSARY

Command-line interface (CLI) – A means of interfacing with a computer by typing in commands on a keyboard. k, as needed.

Embedded – Programs built into machines and stored in ROM.

File server – Hardware and software that together provide file-handling and storage functions for multiple users on a local area network. Storing files on a file server saves having multiple copies stored on individual computers.

Filesystem buffer cache – See Merged-virtual memory.

Merged-virtual memory – A feature within FreeBSD that works with the filesystem buffer cache to create faster disk access and better memory management. Eliminates the need to mess with cache sizes on a regular basis.

Multiple desktops – An operating-system feature that allows different desktop environments to run simultaneously on the same machine.

Multi-threading – Processing more than one transaction at a time within a single program. Multi-threading capabilities will be pervasive throughout an entire OS, not just within a single app.

***NIX** – Any variation of UNIX, including Linux, Solaris, and FreeBSD.

OpenStep – A windows system and software development environment that can function on different platforms.

POSIX-compliant – A standard that defines the language interface between application programs and the UNIX operating system. This allows developers to program apps for compliant OSes.

Pre-emptive multi-tasking – A type of multi-tasking that allows a computer or operating system to interrupt a currently running task in order to run another tas

Protected memory – An OS feature that keeps one program from grabbing memory set aside for another program and corrupting data to that program.

Protected memory allocation mode – A mode in which the OS reserves memory for itself. By switching the processor to this mode, the OS can execute several programs at once, transcending the one-megabyte limit normally enforced on the processor.

Rhapsody OS – Apple's previously anticipated update to Mac OS. Developers abandoned it before it was released because coding apps for it was difficult.

64-bit, journaled filesystem – A filesystem in which updates are automatically recorded in a journal, so if the new file is lost it can be recreated. Because it's 64-bit, it can address immense file sizes.

X – A name for the windowing environment known as X11 for *NIX operating systems. Not to be confused with Mac's OS X, although OS X can use the X11 environment.

x86 platform – A series of processors developed by Intel, used in PCs based on the 80x86 processor architecture (286, 386, 486, 586, 686). The PC as you know it runs on the x86 platform.

UNIX – Multi-user OS usually run in mainframes and high-end hardware. ✸

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This isn't a Sears appliance center—it's 8,192 CPUs and enough hard disk space to hold 300,000,000 books. It's also the Lawrence Livermore Lab's ASCI White, the most powerful computer on the planet.

Forget all the Perfect 10 systems we've reviewed. Forget the $12,000 Dream Machine we built. Forget your own desktop machine assembled from the very, very best parts you could get your hands on. If it can't simulate what happens in the milliseconds after you detonate a nuclear warhead, render 180,000 frames of special effects in a single evening for the next *Star Wars* movie, or defeat the Earth's reigning chess champion, it's not a supercomputer according to *Maximum PC*.

What's the difference between the best available desktop machine and a supercomputer? It has less to do with the rig's size, cost, and CPU power, and more to do with pure performance. In our worldview, for a machine to be classified as a supercomputer, it must offer superlative performance. It must be the best of its class.

Join us as we journey through the roots of the supercomputer and contrast the differences between the original monster machines and those made today.

The Father of Supercomputers

In 1964, Seymour Cray changed the computing world when he introduced the Control Data Corp. 6600, a machine containing 400,000 transistors and 100 miles of wires. The CDC6600 was sold to the Lawrence Livermore Lab for weapons research. Computing historians attribute to the machine the first use of a reduced instruction set; it was able to crank through 10 million instructions a second. With performance a magnitude greater than its mainframe contemporaries, the CDC6600 held speed records for almost five years. Its power only seemed accurately described by the term "supercomputer."

Cray eventually formed his own company, where he built the Cray 1, which he sold to the Department of Defense. Cooled by freon and housed in a C-shaped cabinet with an open horseshoe section, the Cray 1 was shaped so that every wire in the machine was less than four feet long. It could theoretically crank out 160 million floating-point operations per second using a vector processor—mind-numbing performance in those days, but easily attained by today's average PC.

The birth of the Cray 1 marked the golden age of supercomputing. With Cold War contracts in hand, defense contractors,

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SuperComputers

Inside five of the world's craziest power plants

By Gordon Mah Ung

scientific labs, and, of course, the U.S. government kept supercomputer companies in steady business. But like the winnowing of supercar companies, supercomputer manufacturers died as the market demand for hand-built, custom-designed machines dwindled. The end of the Cold War and the manufacturers' inability to keep up with computers designed around commodity parts spelled the end for most of the original supercomputer companies.

Pragmatic designs have mostly replaced the highly customized, exotic designs that defined most of the first supercomputers. Why create a supercomputer from eight custom-built 10,000MHz CPUs when you can build a machine with 800 1.2GHz Athlons? Almost all of today's supercomputers—used for such purposes as safety-testing new cars, analyzing genes, designing drugs, or simulating fluid dynamics to analyze anything from a weather system to the potential results of a nuclear explosion—are fashioned from off-the-shelf components. Instead of designing and fabricating almost every component by hand, manufacturers now construct supercomputers by essentially harnessing the power of many smaller computers, stuffing hundreds or thousands of the same CPUs that go into workstations or desktop PCs into one monstrous machine. Sandia National Lab's ASCI Red, the first supercomputer to break the 1-trillion floating-point-operation mark, is comprised of more than 9,200 Intel Pentium Pro processors. And though the Pentium Pro's heyday is long over on the desktop, ASCI Red continues to be one of the most powerful supercomputers around.

Black Boxes for Black Ops

Who buys these big boxes of unrestrained power? For the most part, supercomputers are being ordered up by The Man himself. After all, who else but the government could afford to splurge on that sort of equipment? This explains why the lion's share of machines logged at **www.top500.org**, a web site devoted to ranking the world's most powerful computers, are listed as "classified." Our very own National Security Agency is rumored to have in its hot little hands some of the most powerful computers on the planet. The NSA spokesman we con-

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tacted would say only that the agency "doesn't comment on operational aspects."

Supercomputer on Your Desktop

If you look at their essential processing power, today's desktop boxes are as powerful as the government supercomputers of yore. After all, the CDC6600 offered an estimated 10MIPS in performance; an 800MHz Pentium III offers about 2,100MIPS. At best, the Cray 1 could perform about 160MFLOPS; a 1GHz Thunderbird Athlon can peak at about 504MFLOPS.

Of course, comparing computers from 30 years ago with today's PCs is like comparing an early Model T to a modern-day Ferrari. Computer performance is all relative—and as the power of the PC has increased, so too has the power of the supercomputer. But even optimistic theorists believe it'll be many, many years before today's supercomputing performance is sitting on your desk. Still, a glimpse at supercomputing today is a glimpse at the desktop PC of tomorrow.

THE SUPER-DUPER COMPUTER

It's simply the most powerful computer on Earth.

Name: ASCI White
Year built: 2000
Location: Livermore, CA
Processing power: 8,192 375MHz IBM Power3-II CPUs
Memory: 6 terabytes ECC SDRAM in 128MB DIMMs
Storage: 196 terabytes
Operating system: AIX

Wrap a high-grade explosive around a ball of plutonium, then try to find out what happens in the milliseconds after you set off your nuclear warhead. Will the plutonium spall and fragment during the ignition? Will a change in the type of explosive change the pattern of the detonation? If you put a circa-1995 supercomputer to work on these questions in 2D, it would spit out the answers in just 6,000 years. If you were looking for 3D simulation, it would take 60,000 years.

Even the U.S. government can't wait that long, so it tapped IBM to build ASCI White at the Lawrence Livermore Lab. Simply put, ASCI White is the most powerful computer ever created. It's the first machine to break the double-digit mark in teraflop performance with 12.3 trillion operations per second—which makes it nearly three times as powerful as the next most powerful supercomputer. To put it in human perspective, it would take every man, woman, and child on the planet doing 2,000 calculations per second to equal the machine's capability.

ASCI White's power comes from running 8,192 375MHz IBM Power3-II RISC chips in a massively parallel architecture. With six terabytes of RAM and a whopping 196 terabytes of storage in 7,000 hard drives, the entire machine occupies more space than two NBA regulation courts and weighs about 106 tons. Its electricity demands could power about 3,000 homes. And if you thought your copper-based CPU fan cooler was special, consider the fact that it takes enough power to cool a small office building to keep ASCI White from overheating. The data ASCI White generates is so voluminous, it takes another supercomputer—a 48-CPU SGI Onyx2 InfiniteReality2 with six terabytes of storage—just to view a portion of it.

Why all this maximum computing? With the ratification of the nuclear test-ban treaty, the U.S. agreed to stop all underground testing of nuclear weapons. ASCI White is not only used to create designs for future weapons, but also to help scientists keep the current stockpile of weapons in shape. Lab officials liken the daunting task of keeping those weapons in shape to storing a 1964 Chevy in the garage: The President says the car must start with a single turn of the key and must perform to within a thousandth of specifications in every category, but no one can ever warm up the car to be sure it's working.

As it turns out, ASCI White won't rule the roost for long. The machine and its little brothers—Blue-Mountain, Blue-Pacific, Blue-Horizon, and Red—will soon play second fiddle to the 100TFLOPS machine Livermore is currently designing. That behemoth is expected to be online by 2004.

MAN VS. MACHINE

IBM's Deep Blue is the only computer to ever defeat a (human) world chess champion.

Name: Deep Blue
Year built: Project began in 1989
Location: Yorktown Heights, NY
Processing power: 28 120MHz P2SC CPUs, two 135MHz P2SC CPUs, and 480 "chess accelerators"
Memory: 32GB ECC SDRAM
Storage: 168GB
Operating system: AIX

Meet Deep Blue, the world's only celebrity supercomputer. Sure, you saw HAL 9000 in *2001: A Space Odyssey*, and WOPR, the out-of-control NORAD computer in *War Games*, but those were just actors. IBM's Deep Blue is a real computer turned celeb, with a "Q" ranking that says more Americans recognize Deep Blue than Batman, Howard Stern, or Austin Powers. The machine even

Deep Blue: More deep than it is blue.

Chess fans watched as IBM's Deep Blue supercomputer beat the bejesus out of world chess Champion Garry Kasparov in 1997. Deep Blue used 480 "chess accelerators" to examine 36 billion positions in a three-minute period.

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Industrial Light & Magic's Render Farm was used to make *Star Wars: Episode One, The Perfect Storm*, and *Saving Private Ryan*.

played a bit part on the animated show "Futurama" as part of former Vice President Al Gore's Nerd Squad.

Deep Blue's claim to fame is an infamous chess match in which the machine challenged world chess champion Garry Kasparov. Capturing the essence of the age-old Man vs. Machine conflict, the Kasparov/Deep Blue face-off began in 1996. According to one of Deep Blue's creators, Murray Campbell, Deep Blue's first match was less than stellar; Kasparov clearly had the upper hand, and in the last game he "sort of toyed" with the machine. But in a May 11, 1997 rematch, Kasparov—who had once declared that a machine would never defeat a man at chess—conceded defeat and left the stage in utter disgust. The 1.4 ton Deep Blue had outplayed the formerly undefeated human champ.

Deep Blue is based on a standard IBM RS/6000 SP computer. The name pays homage to the supercomputer from Douglas Adams' *The Hitchhiker's Guide to the Galaxy* books, Deep Thought, and IBM's own Big Blue nickname. Each of its 30 nodes packs a PowerTwo SC processor clocked at either 120MHz or 135MHz. Every node boasts about 1GB of RAM and 4GB of local storage—which are pretty tiny amounts in the supercomputing world.

"For 1997, it was a small but respectable supercomputer," says Campbell. "But with the special hardware that we designed and programmed at IBM Research, Deep Blue became extremely powerful."

It's Deep Blue's "chess accelerator" chips that set it apart. In the same way that a GeForce2 Ultra accelerates the hell out of polygon rendering, Deep Blue employs custom-designed chips that accelerate the idiosyncratic computations used in chess. Each chess accelerator looks at a position on the board and scores it according to its strategic superiority. It also examines current positions, and considers the way any particular move will impact the game. A single chess accelerator can evaluate from 2 to 2.5 million chess positions per second—and IBM plugged 480 chess processors into Deep Blue's MicroChannel slots. During the three minutes in which a player is allowed to make a move, Deep Blue examines 36 billion possible positions. Kasparov didn't stand a chance.

Want to program your general-purpose CPU to emulate Deep Blue? Researchers estimate it would take about 5,000 instructions to evaluate a single chess position. Looking to set up a chess match between Deep Blue and another supercomputer? Deep Blue's competitor would need to offer about 1 trillion instructions per second in performance. Currently, only a handful of supercomputers would qualify.

IBM retired Deep Blue from the chess circuit in 1997 as the reigning computer champion of chess. Blue now spends its days at an IBM research lab in Yorktown Heights, doing data mining. Researchers say they're ready to pull Deep Blue out of retirement should a challenger come forth—but so far, there've been no takers.

"JAR JAR, I AM YOUR FATHER."

This monster brought to life *Star Wars: Episode One—The Phantom Menace*.

Name: Render Farm
Year built: 1996
Location: San Rafael, CA
Processing power: 740 MIPS 400MHz R12000 processors
Memory: 740GB ECC SDRAM
Storage: 12 terabytes
Operating system: IRIX

It's the creator of the most controversial movie character to hit theater screens in the late 1990s. Meet Industrial Light & Magic's Render Farm, the supercomputer that made Jar Jar Binks possible. But whether you love or hate the floppy-eared *Star Wars* character, you have to appreciate the computing power that made him the most realistic digital character ever to hit the big screen.

He's the most realistic digital character ever to grace the screen (and possibly the most annoying). It took many CPU cycles to bring Jar Jar Binks to life.

Although individual desktop and workstations pull yeoman duty, most of the heavy lifting at ILM is done by the Render Farm, an SGI Origin 2000 super-computer outfitted with 740 400MHz MIPS R12000 CPUs. After artists finish building 3D scenes or models for a movie on their individual workstations, the Render Farm steps in. Since the individual workstations don't have the power to mow through the thousands of frames it takes to create fluid animation for a scene, the work is compiled and lined up every night to go through the Render Farm.

On average, each frame is rendered at a resolution of 2000x1000, says Andy Hendrickson, director of systems development at ILM. In a single evening, ILM can render 180,000 of those frames. It would take your 400MHz Pentium II about 20 years to render that many frames.

The Render Farm takes full advantage of SGI's cache coherence non-uniform memory access (ccNUMA) architecture to pass data from node to node at incredibly high speeds. Instead of relying on a bus with a fixed bandwidth to communicate data between processors, the Render Farm intertwines the CPUs in a mesh of fabric architecture that allows all of the machine's CPUs to work as they do without hitting a bottleneck. And because there's no fixed bandwidth, ILM has successfully added more and more CPU nodes without bogging down the system.

The Render Farm isn't all located in the same building; it's spread out among several different rooms. If concentrated into one room, the Render Farm would take up about 10,000 square feet of space. The machine is constantly being upgraded and maintained by a staff of 18 who add more hard-drive racks, memory, and CPU nodes as needed.

Rendering movies requires huge amounts of storage capacity—ILM is currently working with 12 terabytes of disk space in fibrechannel arrays and constantly adds more hard drives. Creating movies also takes a tremendous amount of network bandwidth; roughly six terabytes of data are transferred through ILM's gigabit Ethernet network every night.

Hendrickson says it's difficult to measure the performance of the Render Farm in

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terms of traditional benchmarks, but he notes that smaller versions of the Render Farm employed by other companies are at the top of the Top500.org list. Hendrickson believes that the only way to measure the Render Farm's speed is to consider the number of movies the company can work on at any given time. This year, the company will polish off 12 movies, including *Star Wars: Episode Two*, *Planet of the Apes*, *Jurassic Park III*, *Pearl Harbor*, and *The Mummy Returns*. For the purpose of comparison, consider that it took ILM a year to assemble the computer graphics for the first *Jurassic Park* using the state-of-the-art hardware of the early 1990s—and that the first *Jurassic Park* only had a few minutes of CG, versus the effects-heavy movies of today.

"Our computers have grown by leaps and bounds, but we're still constrained by computers," Hendrickson says. "In *Star Wars: Episode One*, Jar Jar was completely synthetic. We're talking about doing humans, which is much harder because everyone knows what to expect—no one had ever seen a Gungan before."

VIRTUAL REALITY LIVES

A supercomputer brings your dreams of space travel to life.

Name: Digital Dome System
Year built: 1999
Location: New York, NY
Processing power: 28MIPS R10000 200MHz CPUs
Memory: 14GB SDRAM
Storage: 2 terabytes
Operating system: IRIX

Despite supercomputers' awesome number-crunching abilities, your average desktop machine equipped with a GeForce2 Ultra videocard could probably whup most of the monsters in a battle of 3D-display prowess. After all, most supercomputers use other machines to view the data they produce. The shining exception is the Hayden Planetarium's Digital Dome System, which employs the most powerful virtual reality simulator available to the public. Housed at the Rose Center for Earth and Space in New York City, the machine is as close to the stars as you can get without going through NASA training.

"We essentially have one heck of a display device," says Jim Sweitzer, director of astrophysics education at the Rose Center. "It's a real 3D simulator, and anything we can construct in 3D, we can project. It's extremely convincing."

Convincing is right. Audiences in the Dome usually duck out of the way of the virtual objects. Aram Friedman, director of engineering at Hayden, says the realism is born from the way humans perceive images a curved surface and the computer's ability to play on those geometric illusions. For example, even though you know you're inside a dome, the system can absolutely convince you that you are sitting inside a square room.

A true cosmic flight simulator with accurate positions of our galaxy's stars, the current show takes visitors on a virtual trip to the Orion Nebula—"one of the most interesting places in astronomy," according to Sweitzer. The journey begins on Earth and rumbles through space on a whiplash trip past Saturn, eventually settling into the Nebula Orion. There, visitors are treated to a front-row view of the birth of stars.

The secret sauce in the Digital Dome System is a combination of the computer itself and seven Trimension/SEOS projectors that paint 1280x1024 images—that's about 7 million to 9 million pixels—onto the interior walls of the Digital Dome, which can seat up to 430 people.

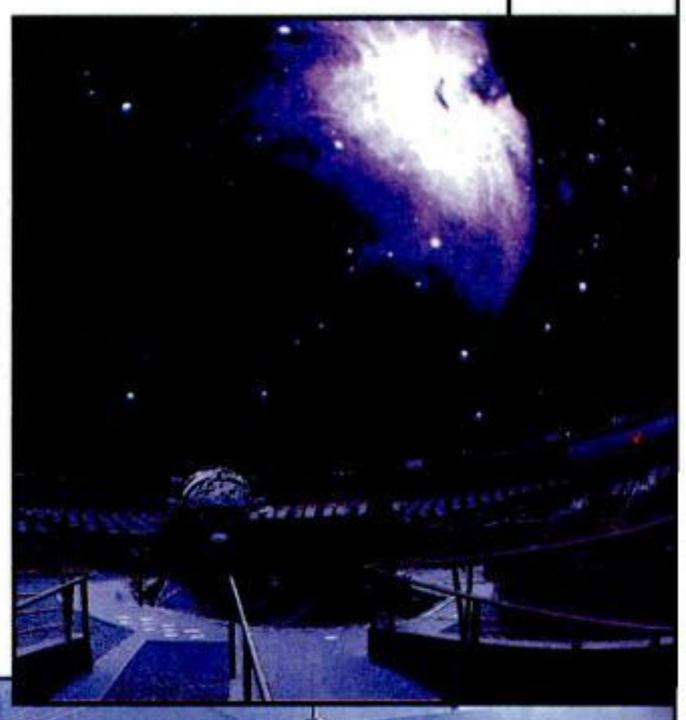
The Dome System's computer-controlled Zeiss star projector is capable of projecting "billions and billions" of stars and identifying specific objects with its laser, but the backbone of the technology—the computer hardware—steals the show. The actual computing power behind the Digital Dome comes from a Silicon Graphics Onyx2 InfiniteReality 2 supercomputer. Equipped with 28MIPS R10000 CPUs, the Digital Dome's SGI system is specially outfitted for visualization duties and can pump about 93 million polygons a second through its seven pipelines.

The guts of the Digital Dome are too large to fit inside the sphere-shaped building. Instead, the machine is buried in the bowels of a neighboring building, surrounded by its own personal air conditioning system.

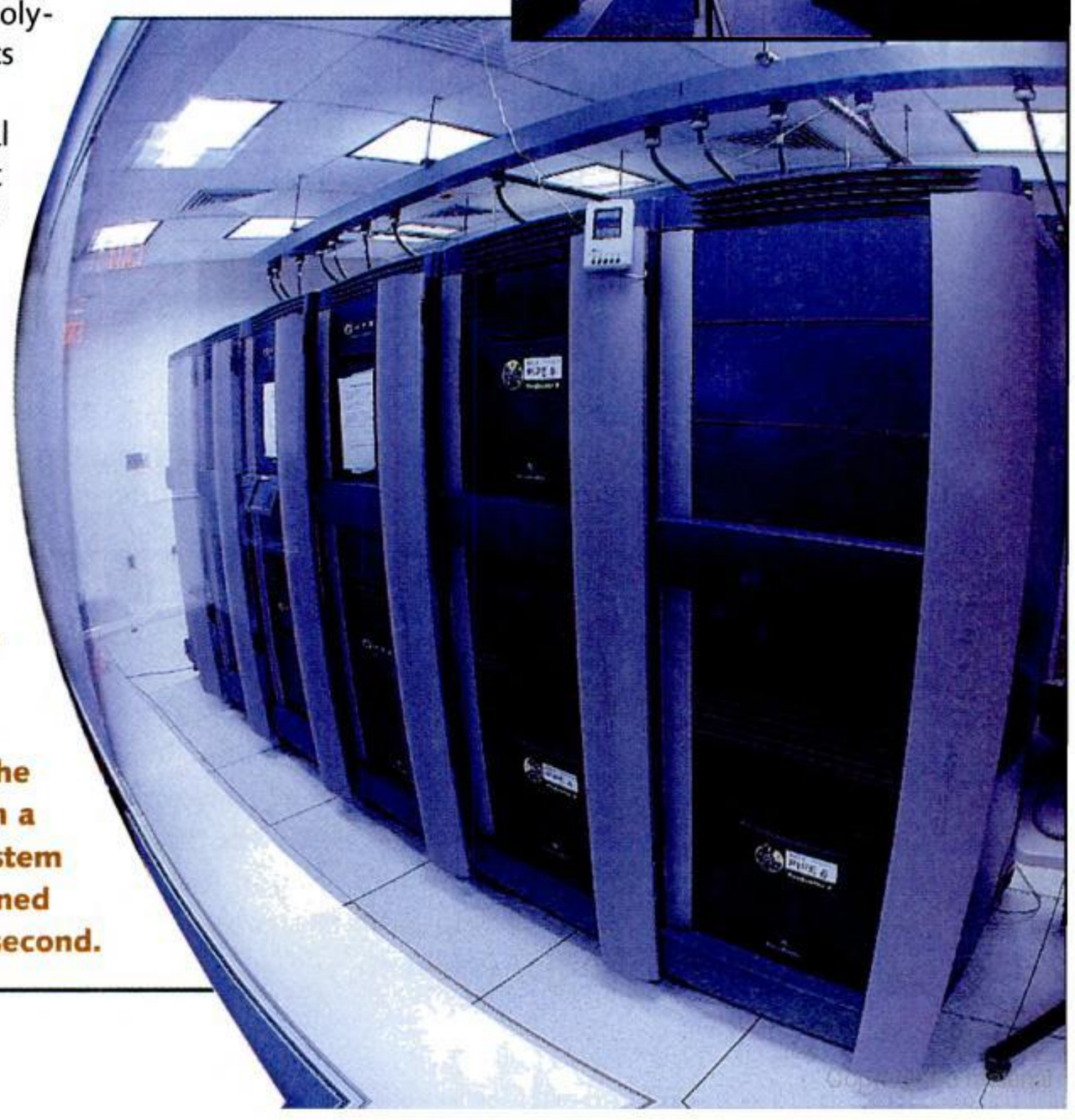
Even with the graphics muscle of the Onyx2, the entire Orion Nebula show can't be rendered in realtime. It took a 1,000-CPU machine at the San Diego Super Computer Center around 17 hours to render the Orion sequence. After the public tours are over, the Digital Dome turns into a scientific center. Astrophysicists and astronomers grab popcorn and explore accurate simulations of globular nebulas and watch stars collide in realtime.

The big question of course is, Could you play video games on it? Friedman wouldn't specifically comment but said, "We have seen some cool things." You certainly couldn't run an off-the-shelf game such as *Quake III Arena*, as the game would have to take advantage of the multiprocessor environment and the separate graphics pipelines.

The planetarium is developing new shows for the public and is also looking at the possibility of moving to a distributed computing environment using PC-based technology and high-speed networks. Other possible plans for the future include a projector system that uses lasers



By playing with optical illusions, the Digital Dome transforms itself into a 21st-century Holodeck. The system is capable of taking you on a tour of the Orion Nebula.



The Digital Dome's heart is a 28-processor SGI Onyx2. Though quite small on the supercomputer scale, the Onyx2 is equipped with a seven-pipe graphics system that can pump a sustained 93-million polygons a second.

instead of glass tubes, once they get past the "safety" issues.

"It's as close to a Holodeck as you're ever going to get," Friedman says.

THE WORLD'S LARGEST SCIENCE PROJECT

A collective of PCs and Macs may be our best hope for finding extraterrestrial life.

Name: SETI@Home
Year built: 1998
Location: Everywhere
Processing power: 2.5million CPUs
Memory: 76 petabytes
Storage: 24 exabytes
Operating system: Windows 9X, NT, 2000, Mac OS8, OS9, Linux, Be, Unix, AIX, Irix

According to David Anderson, the most powerful computer on Earth isn't owned by a company or the government. Anderson, the director of the SETI@Home project, says the most powerful rig in town is owned by you.

"It is the world's biggest supercomputer," Anderson says of SETI@Home. "It's about 2.5 times as powerful as ASCI White."

Though traditionalists will disagree, Anderson may have a point. SETI@Home isn't a supercomputer filling several rooms in a building—it's a computing project that uses the collective power of millions of computers across the globe. By SETI@Home's estimates, the 2.5 million computers crunching numbers give the project about 25 trillion floating-point operations per second. That's about double what ASCI White can do.

SETI@Home takes scans of the sky from the Arecibo radio telescope in Puerto Rico and slices the gigabytes of data into 300KB pieces. Those pieces are distributed through the Internet to participants' machines where they're analyzed for signs of intelligent extraterrestrial life. On most folks' computers, the SETI@Home client runs as a screen saver that kicks in whenever possible to analyze the data.

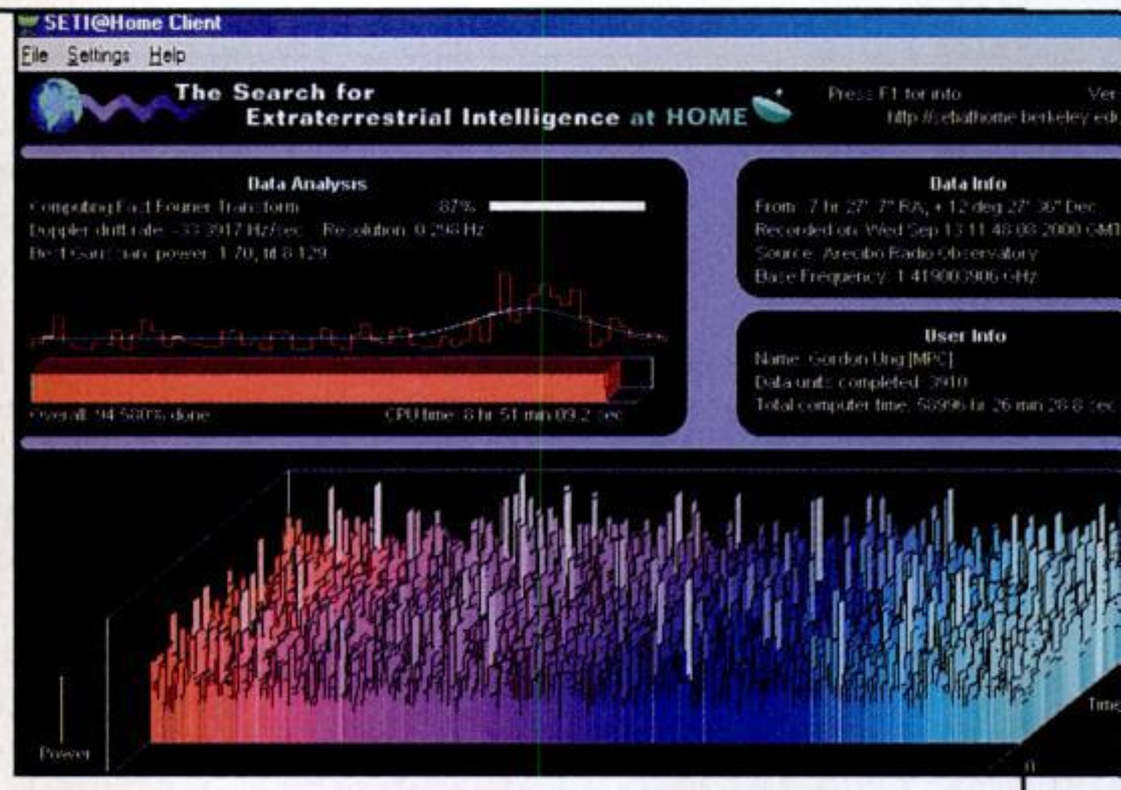
This manner of harnessing supercomputing power is actually more accurately described as "distributed computing." And even Anderson admits it's a bit of a stretch to try to compare SETI@Home's distributed approach with that of a traditional supercomputer.

"To say SETI@Home is twice as powerful [as ASCI White] is over-simplifying things, but in terms of the amount of computing getting done, [SETI@Home] is twice as fast."

The distributed computing model won't work for all supercomputer-worthy operations. Many weather and fluid-analysis simulations, for example, require massive amounts of local memory. Another limiting factor is latency: Most supercomputers employ terabytes of storage and memory to get data from one CPU node to another CPU in milliseconds or nanoseconds. SETI@Home can send a work unit out to be processed and not expect an answer for days, weeks, or months.

Still, the 2.5 million computers currently involved in SETI@Home are generating a mind-numbing amount of power. Were there only 32MB in every machine running the client, the total memory available would be about 76,294 terabytes (that's 76 petabytes). If every machine had a 10GB hard drive, that would give the project about 24,000 petabytes, or 24 exabytes, of storage.

SETI@Home's most limiting factor has been bandwidth to the Internet. The project's servers at the University of California at Berkeley consume 30 percent of the university's bandwidth. To prevent it from eating all of the school's bandwidth, the project has been capped at 30MB/sec. SETI@Home has compensated for the bandwidth limits by adding more scientific analysis capabilities to the client and increasing the time it takes to complete a work unit. But, as thousands of people each day join the project by downloading the SETI client onto their PCs, "there's really no practical limit," Anderson says of the project.



This SETI@Home screen saver represents the most powerful computing force in existence right now. Using the downtime from your CPU at home or at work, the project harnesses more than 2.5 million computers around the world.

THE FUTURE

You run *Word* and *Internet Explorer*. On occasion you fire up *Photoshop* and *Winamp* at the same time. Sometimes, you even capture digital video to your computer. "Why the hell would I ever need the equivalent of 300,000,000 books in storage space or enough computing power to make a nuke?" you may ask yourself.

Perhaps you're being shortsighted. After all, "enough is enough" was probably muttered when the power switch was thrown on the ENIAC. And some scientists likely predicted that they'd never need "that much" computing power when the first Cray 1 was delivered to their lab. And you may even have said of the 486, Pentium 133, or Athlon 1GHz, "Who needs all that power?" You do. And you'll likely see much, much more in your lifetime.

Advances in optical, bio, and quantum computing technology will make today's silicon-based supercomputers seem less powerful than a busted up VIC-20.

IN THE WINGS...

Seymour Cray's first love-child at Cray Research was the Cray 1. Capable of a then-incredible 160MFLOPS of performance, the Cray 1 was cooled by freon and shaped like a C to help keep the cable runs under four feet.

Sandia National Labs scientist Michael Hannah pokes around the inside of ASCI Red. The first computer to break the 1-trillion floating-point operations barrier, Red was built using 9,200 Intel Pentium Pro processors.

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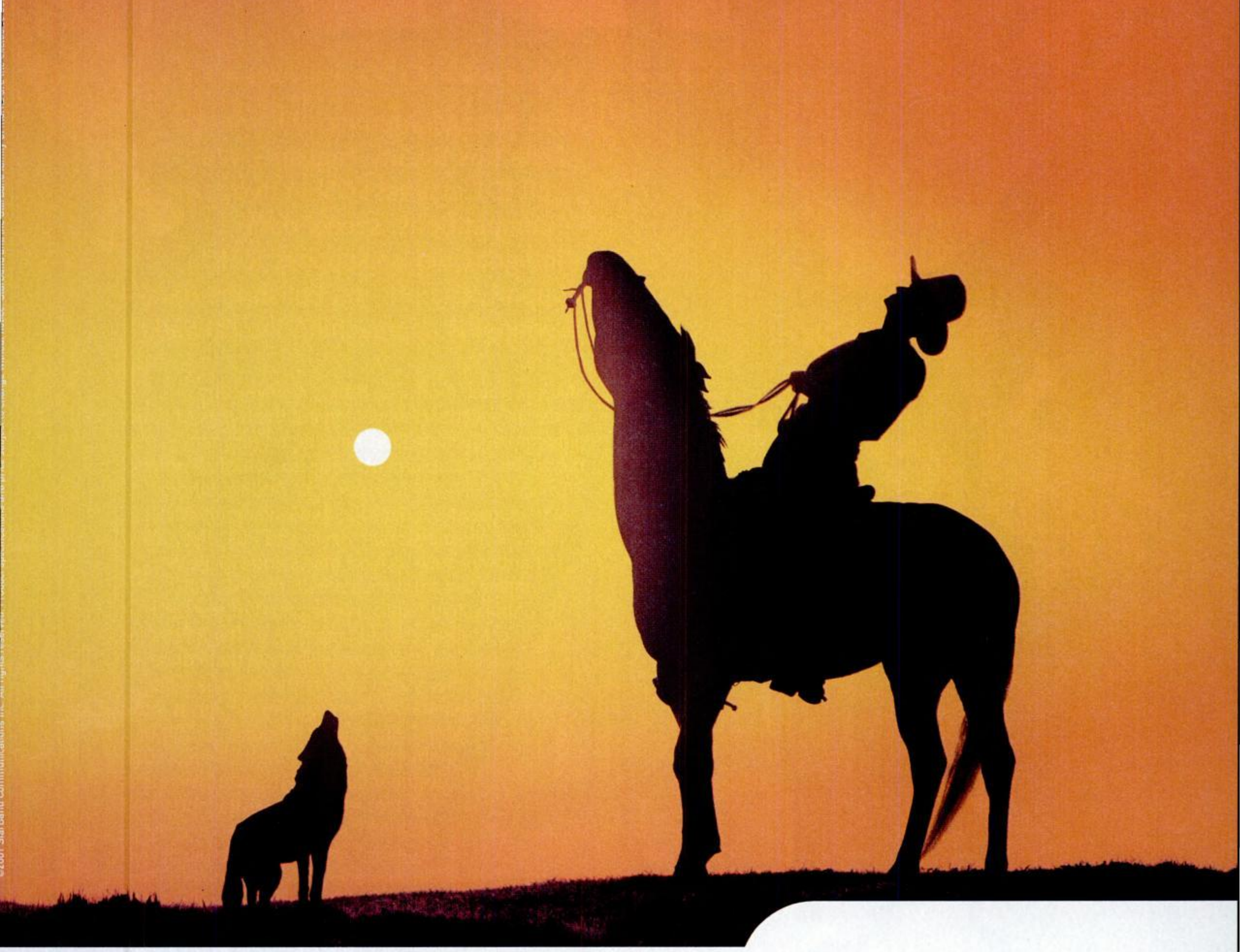

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IDE VS.

Which storage interface will win our Data Bus Beauty Pageant? We pit IDE against SCSI in five competitions: speed, data integrity, device support, RAID support, and pricing. Polish the tiara—a winner is approaching the catwalk!

AMD vs. Intel. nVidia vs. 3dfx. Creative Labs vs. Aureal. PC gearheads love arguing the merits of direct competitors. Such debates have raged for many a moon, but one argument seems to outlast all others: IDE vs. SCSI—which is superior? And for whom?

IDE and SCSI are the two leading interfaces for connecting storage devices to PCs. They allow hardware such as hard drives and CD-ROM drives to communicate with the PC's CPU subsystem (which is comprised of the CPU, core-logic chipset, and RAM). The IDE interface is a 16-bit-wide channel that connects to the system bus via the PCI bus. The circuitry that controls the IDE bus is integrated into the southbridge portion of a motherboard's core-logic chipset. SCSI, on the other hand, is an independent bus that requires a host adapter to handle commands generated by devices attached to the bus. Which interface you choose determines, to some extent, the performance of peripherals attached to it and how easy it will be to upgrade or add new components to your system. Choosing the best hardware for your needs is only half the battle. Picking the most appropriate bus interface—IDE or SCSI—is the other half.

SCSI components have traditionally offered better performance than IDE devices. The reason is simple: Because the SCSI interface grants higher peak

ILLUSTRATIONS BY ELIZABETH BRANDT

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SCSI

by Josh Norem

throughput speeds, drive manufacturers have always stuffed their latest and greatest mechanical technology in SCSI devices (for example, spindle speeds for IDE hard drives top out at 7,200rpm, while SCSI drives enjoy spindle speeds in excess of 10,000rpm). As a result, SCSI devices have always cost more.

But the situation has changed recently. IDE devices have begun to match SCSI devices in terms of reliability and internal speed, and are able to do so without costing a paycheck. In fact, many power users have ditched SCSI due to its high price and dwindling performance edge. A perfect example can be found in the components we used to test the two competing interfaces for this article. We used two nearly identical Plextor CD-RW drives—the drives contain the exact same internal hardware and simply run on different buses. In our benchmark tests, the IDE drive actually ran a tad faster than the SCSI drive. This came as no surprise: SCSI drives have extra reliability features (such as error-checking) that add to their overhead. What's more, IDE drives attach directly to the PC's system bus, whereas SCSI commands have to pass through the SCSI bus before proceeding to the system bus.

Performance numbers tip toward SCSI's favor in systems with multiple devices installed. In these cases, SCSI offers a speed advantage because it can handle multiple commands from multiple devices simultaneously. The IDE bus, meanwhile, can't multitask like this; it must complete a request from one device before it can receive another. SCSI is thus ideal for multi-threaded OSes such as Windows 2000 (which also means that single-tasking OSes such as Windows 98 don't take full advantage of SCSI's capabilities).

To determine which interface is the "best," we pitted them against each other in a series of mini-competitions to determine an "overall winner." Just remember: Even the loser has its share of benefits and may indeed be the best bus for your needs.

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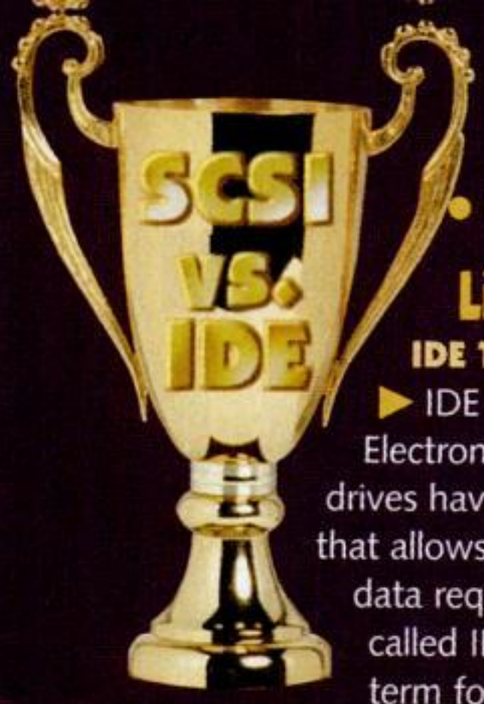

Lingo Lesson

IDE Terms

- IDE (Integrated Drive Electronics): All current hard drives have an integrated controller that allows them to send and receive data requests. These drives are called IDE, which is a generic term for any drive with an integrated drive controller.
- ATA (AT Attachment): This term is nearly interchangeable with IDE. The ATA bus originated in 1984 with IBM's AT computer, which carried the first 16-bit ISA bus. AT Attachment, therefore, identifies any drive that can be plugged into the AT-bus.
- ATAPI (AT Attachment with Packet Interface): This protocol was integrated into the ATA spec when ATA/33 was rolled out, allowing both hard drives and other storage devices to use the IDE interface. ATA was originally written to work only with hard drives, so the addition of ATAPI to the specification cleared the way for other devices that attach to a PC via a common interface. ATAPI devices include CD-ROM drives, CD-RW drives, tape drives, and other removable storage devices. ATA devices receive commands one at a time, but ATAPI devices receive commands in packets, hence the name "packet interface."

SCSI Terms

- SCSI (Small Computer System Interface): A parallel interface used to connect peripheral devices to a PC, SCSI differs from IDE in that it requires a separate host adapter to handle requests from devices attached to the bus.
- Command queuing: This feature originated with SCSI-2 and allows the devices attached to the SCSI bus to accept multiple commands simultaneousl, and then execute them in the matter deemed most efficient by the device.
- Disconnect/reconnect: This feature, found in SCSI-2 and later models, allows for devices attached to the chain to connect and disconnect from the SCSI bus extremely rapidly (taking only 350 microseconds), which frees up the bus to handle other requests.
- Domain validation: This feature was added with Ultra160 SCSI and allows the host adapter to first negotiate the fastest transfer rate possible with a device. Next, the adapter tests the connection to determine the fastest rate at which successful transfers can be made.

Peak Throughput Speed

Both IDE and SCSI perform according to standards developed by component manufacturers. For example, Quantum developed the ATA/33/66/100 specs, which were later approved by the American National Standards Institution (ANSI). These standards define the upper limit of performance for all devices that conform to the spec. The Peak Throughput competition is thus a battle between ATA/100 and Ultra160 SCSI, the latest (and fastest) versions of the IDE and SCSI specs, respectively.

A word about "peak throughput": This is the fastest possible speed the bus can achieve and usually only happens when a drive's memory cache (a.k.a. data buffer) is flooding the bus interface. In our hard-drive and CD-RW drive reviews, we typically focus on average throughput, which is more dependent on a drive's internal mechanics than its bus interface. Nonetheless, peak throughput is an important consideration, especially in bus-intensive applications such as DV encoding and serving database information.

IDE: As the specification implies, ATA/100 components can transmit data at speeds up to 100MB/sec. This specification is rumored to be the last of the "vanilla" ATA specifications to be announced; the industry is making way for the new Serial ATA interface being developed by Intel. Industry sources speculate the four-channel Serial ATA interface will offer 150MB/sec throughput in its first iteration and eventually top out at around 500MB/sec in a few years' time. Rumors abound that an ATA/133 spec will surface prior to Serial ATA.

SCSI: Although Ultra320 SCSI has been announced, products have yet to hit the marketplace as of press time. Therefore, the flag bearer for SCSI is Ultra160 SCSI. This spec allows for transfer rates up to 160MB/sec, which is 60MB/sec more than the fastest IDE standard (ATA/100) allows.

Winner: SCSI is the clear winner in terms of sheer peak throughput. Although the latest generation of IDE (ATA/100) puts old-school Ultra2 SCSI to shame, the latest version of SCSI (Ultra160) trounces even ATA/100.

Special Features

Both the IDE and SCSI specs include data integrity features. SCSI goes one step further with features that help orchestrate the swift exchange of data.

IDE: The primary data integrity features for IDE hard drives are S.M.A.R.T. technology and CRC.

S.M.A.R.T. is a reliability-prediction technology developed by IBM; it stands for Self-Monitoring, Analysis, and Reporting Technology. Here's how it works, according to Quantum: "The disk-drive software monitors the internal performance of the motors, media, heads, and electronics of the drive, while the host software monitors the overall reliability status of the drive.

The reliability status is determined through the analysis of the drive's internal performance level and the comparison of internal performance levels to predetermined threshold limits." Sounds sweet, indeed, and it comes in handy for people worried about impending hard-drive doom.

Cyclical Redundancy Checking (CRC) is a technique used to check the integrity of data being sent across the bus. In CRC, the host controller and its attached drive calculate a value for each data transfer. After the data is sent, a new value is created and compared to the original. If a difference is reported, the host may select a slower transfer speed (to ensure better reliability) and send the data again.

SCSI: The SCSI interface offers a plethora of features that increase security and performance. First, there's parity, which is a form of error-checking that ensures the reliability of all data transfers. Almost every SCSI host adapter supports parity. With the release of Ultra160

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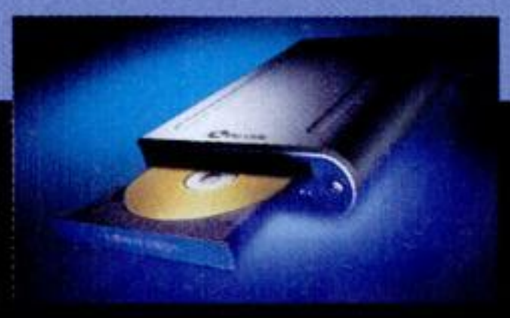
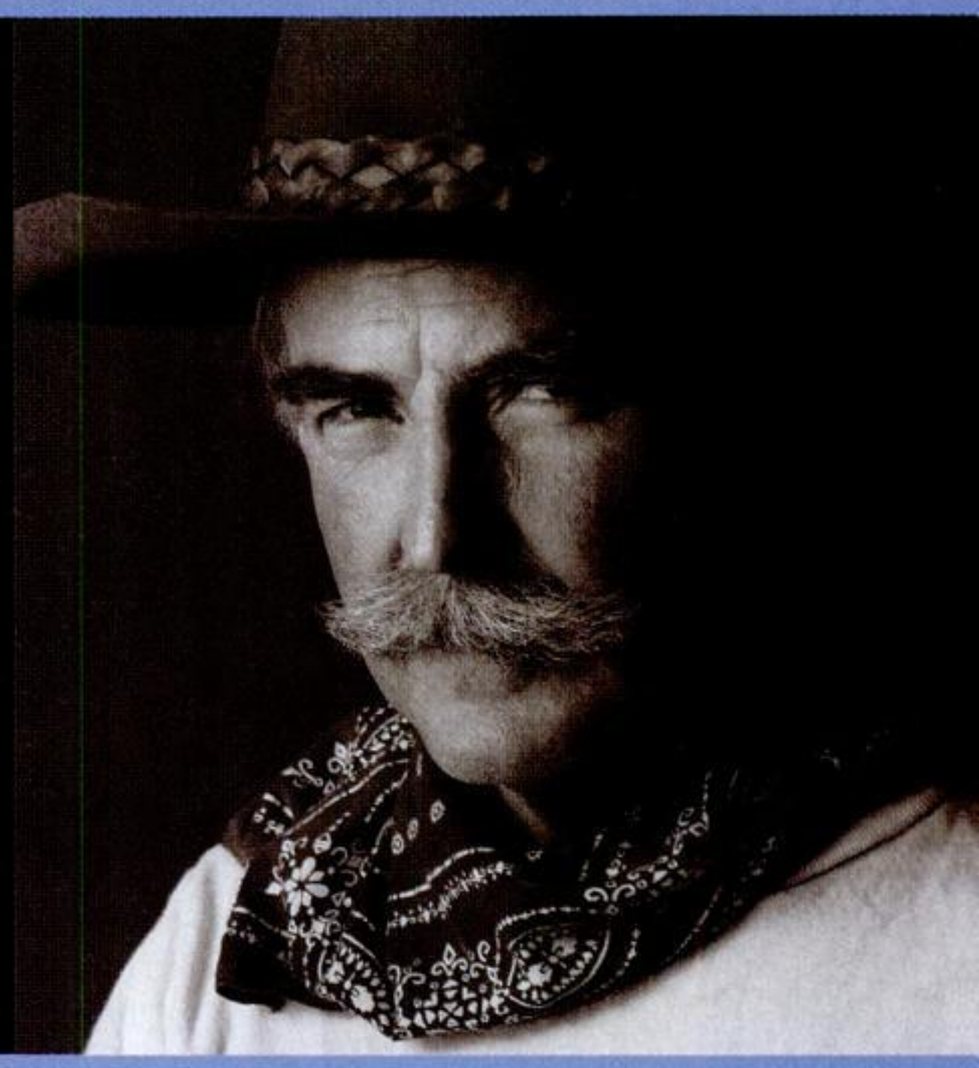


"Tell me again why I need a new Plextor drive — and smile when you say it."



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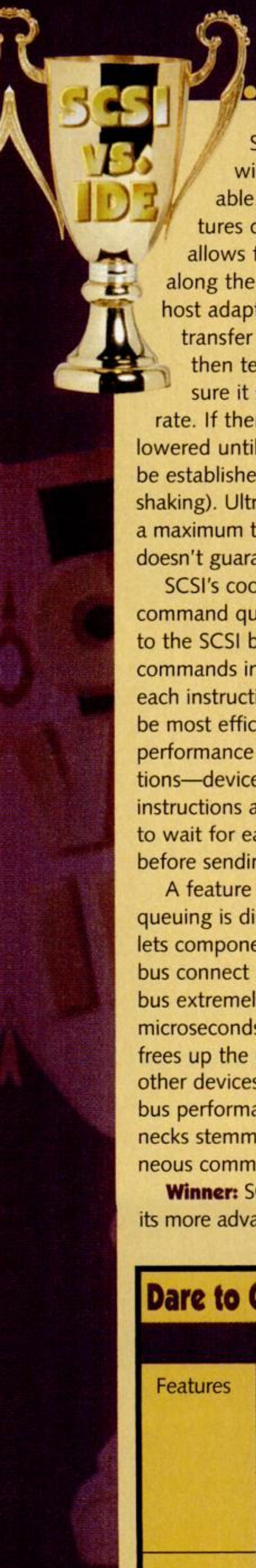

SCSI, parity was replaced with CRC, which is more reliable. Ultra160 SCSI also features domain validation, which allows for optimized transfers along the bus. During bootup, the host adapter negotiates the maximum transfer rate to each device and then tests the connection to make sure it supports transfers at that rate. If there's a problem, its rate is lowered until a reliable connection can be established (similar to modem handshaking). Ultra2 SCSI is able to negotiate a maximum transfer rate to devices, but doesn't guarantee that rate in all transfers.

SCSI's coolest feature might be command queuing. A device attached to the SCSI bus can store up to 256 commands in a queue and then execute each instruction in the order it deems to be most efficient. This greatly improves performance in multitasking applications—devices can send numerous instructions at once rather than having to wait for each request to be fulfilled before sending another.

A feature related to command queuing is disconnect/reconnect, which lets components attached to the SCSI bus connect and disconnect from the bus extremely rapidly (taking only 350 microseconds). This ability to disconnect frees up the bus to handle requests from other devices. Ultimately, this improves bus performance—gone are any bottlenecks stemming from conflicting simultaneous commands.

Winner: SCSI wins this one by virtue of its more advanced device communication techniques. IDE has basic data protection schemes in place, but the SCSI interface can handle so much more traffic than IDE, it's not even a close contest. When used with a multi-threaded OS, the SCSI bus can work on a slew of commands at once without even breaking a sweat, while IDE threatens to stutter when just two devices are running at once.

Number of Devices Supported

The number of devices supported by an interface always figures into building or upgrading a system. It's best to keep your options open, so you'll want an interface that not only meets your present demands, but also allows for future expansion.

IDE: The IDE bus supports up to four devices across two channels. When two devices share a single channel, they must be configured in a Master/Slave relationship. This requires setting jumpers on the drives themselves so that both drives don't simultaneously respond to requests from the system. This relationship doesn't impact the performance of either drive, but the necessity of a Master/Slave relationship limits the number of devices that can share the channel. This two-device-per-channel limit is the worst shortcoming of the IDE bus.

SCSI: The SCSI bus supports up to 7 devices on a regular (narrow) bus and 15 devices on a "Wide" bus. Devices are daisy-chained together, and each device must be given a SCSI ID. Some SCSI host adapters have dual channels, allowing up to 30 devices to be connected on a single Wide bus. Not only does SCSI support more devices per channel, it also supports a wider range of peripherals (e.g., printers, scanners).

Winner: Once again, SCSI emerges victorious. Due to cable length issues, it's a major pain in the hindquarters to connect four IDE devices to a PC; SCSI alleviates this agony by allowing up to seven devices to share a single cable. Although properly terminating a SCSI chain can sometimes be problematic, SCSI is largely plug-and-play and more easily allows adding devices to a PC.

RAID Support

In the old days, RAID (Redundant Array of Inexpensive Disks) was only used for massively expensive corporate servers. That's all changed with the introduction of ATA/66/100 hard drives that are lickity-split fast and dirt-cheap. Now, everyone is doing RAID—so which interface rules the roost?

IDE: Because of its relatively low cost and substantial speed boost, striping IDE hard drives together has become a favorite pastime of PC power fanatics. IDE hard drives are nipping at the heels of the fastest SCSI drives when it comes to sequential read and burst speeds, so slapping two of them together often leads to better performance than that of a single SCSI drive. Case in point: The Dream Machine 2000's 15,000rpm Seagate X15 SCSI drive posted slower sequential read speeds than two IBM 75GXP IDE drives striped together in a RAID 0 configuration—a configuration that offers substantially more storage space for hundreds of dollars less than the single SCSI hard drive.

Dare to Compare Here's a little cheat sheet on the most popular IDE and SCSI specs.

	ATA/33	ATA/66	ATA/100	SCSI	Ultra2 SCSI	Ultra3 SCSI
Features	Graduated from 8-bit to 16-bit transfers; added S.M.A.R.T. monitoring.	Added integrated ATAPI support, advanced power-management support, and BIOS support for hard drives larger than 8.4GB.	Increased burst speeds up to 100MB/sec.	Optional bus parity, passive termination.	Graduated from 8-bit to 16-bit transfers; command queuing added.	Fast-80DT (Double Transition) clocking, CRM, domain validation, *packetization, *Quick Arbitrate and Select (QAS)
Transfer speed (MB/sec)	33.33	66.67	100	4 to 5**	10 to 20**	**80 to 160
Transfer width	16-bit	16-bit	16-bit	8-bit	8-bit/16-bit for wide	16-bit
Clock speed (MHz)	NA	NA	NA	5	10	40

*Available only with Ultra160+ components. **Features vary according to different iterations of the spec.

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SCSI RAID may be the RAID of choice for corporate networks, but for home users, IDE RAID is faster, less expensive, and easier to maintain. The only downfall with IDE is that it's unable to run RAID 5 (striping with parity) because most IDE RAID controller cards don't support this configuration. However, only the most hardcore power users would ever use RAID 5 on their home system; it's simply too expensive.

SCSI: SCSI RAID is extremely expensive. A run-of-the-mill SCSI RAID controller costs around $1,000, and two 10,000rpm SCSI hard drives cost another $600. What's more, this configuration might actually perform worse than an equivalent IDE configuration in a single-user desktop environment, while costing four times as much. In an enterprise environment with thousands of simultaneous requests, SCSI RAID will whip IDE RAID like a read-headed step array, but we're talking desktop computing here, and SCSI RAID is simply too expensive to recommend for single users with singletasking operating systems.

Winner: *Maximum PC* is a magazine for home power users, so we're handing this victory to IDE RAID. Although SCSI RAID is the storage medium of choice for enterprise applications, it's not cost-effective for home use. Oh, and did we mention we've had nothing but problems with SCSI RAID lately? (See "I'd Sell My Soul for a Perfect 10," November 00.) OK, we're a bit biased after "DPTgate," but IDE RAID support is already shipping on brand-name motherboards, so it's certainly a technology that has come of age.

Pricing

Getting the most performance for the least amount of moola is the prime directive. SCSI has always been more expensive than IDE due to its advanced architecture and the fact that it requires an add-in host adapter. On the other hand, IDE is relatively inexpensive, and support for it is included on every motherboard produced. That stated, let's talk numbers:

IDE: At press time, the top dog in the IDE hard-drive world is the 75GB version of the IBM 75GXP—a $350 drive. Read speeds average approximately 29MB/sec, and it bursts at approximately 83MB/sec. Even better, two of these drives in RAID 0 are able to achieve read speeds approaching 40MB/sec. For the money, the performance is simply phenomenal and equals approximately $4.50 per gigabyte. IDE CD-RW drives have also come down in price and generally provide stellar reliability, thanks in part to the addition of Burn Proof-like technology. (Before the advent of Burn-Proof, SCSI ruled the CD-RW drive kingdom because its special multitasking features and high peak throughput rates helped preclude buffer underruns.)

SCSI: It's no wonder that SCSI has earned the pseudonym "Serious Cash Sucking Interface." A 75GB SCSI hard drive is likely to cost about $1,000, and the add-in controller card will run you from $200 to $1,000. SCSI hard drives are as fast as sin but aren't worth the investment for anyone in a single-user, singletasking environment.

Winner: When it comes to pricing, SCSI receives a serious beatdown. For home users, IDE devices deliver fantastic performance for a relatively low cost. SCSI has its feature advantages for workstation/server applications, but you'll pay for them.

And the Winner of the Bus Beauty Pageant Is...

SCSI is technologically superior to IDE in every way possible, so based on sheer features and robustness, we hand the tiara to SCSI. However, the very fact that there are two thriving bus interface choices indicates that each has its merits. IDE is the most rational choice for home users—support is included on every motherboard, and it costs relatively little. People working in a single-person, Win9x environment should stick with IDE. People looking for the absolute fastest interface, or those working at a workstation level, should go with SCSI.

The Benchmarks

To compare IDE and SCSI, we benchmarked two nearly identical components: Plextor's 12/10/32A CD-RW drive and 12/10/32S CD-RW drive. The "A" model runs on the IDE bus, while the "S" model runs on the SCSI bus. Aside from their interfaces, Plextor says the drives contain essentially identical internal hardware.

When comparing similar components on different buses, IDE hardware typically runs a tick faster due to the IDE bus's reduced overhead (at least in singletasking environments). SCSI used to be the preferred interface for CD duplication, thanks to its reputation for trouble-free burning. However, with the advent of buffer underrun prevention technology in IDE drives, SCSI has virtually lost this historical advantage.

We would have liked to have compared SCSI and IDE hard drives, but we had trouble finding fast, modern drives with identical internal hardware. The problem is that 7,200rpm SCSI drives went out of vogue quite a while ago, and those that remain include internal hardware that would be smoked by today's 7,200 IDE drives. We asked all the top hard drive manufacturers to supply us with drives for an apples-to-apples comparison, but none could accommodate us in time for this article.

Also, please consider that these benchmarks were performed under Windows 98, with no other applications running in the background. If we were to test CD-RW drive performance in Win98 while other tasks were running in the background, we'd expect the SCSI drive to speed along and the IDE drive to bog down under the weight of multiple requests.

CD TACH	IDE PLEXTOR	SCSI PLEXTOR
Avg. sequential read (MB/sec)	3.6	3.6
Random access (ms)	127	**122**
Max CPU utilization	6%	**5%**
AUDIO EXTRACTION		
Max. extraction speed	24.5x	24.5x
Time to rip 340MB	**2:05**	2:42
CD MASTERING		
Data CD creation	**6:55**	6:59
Mixed-mode CD duplication	**9:33**	10:00

NOTES: Bolded scores indicate winners. IDE tests were conducted with the drive set as Master of secondary IDE channel. SCSI tests were conducted with an Adaptec 39160 host adapter. Test machine: Dell XPSB 733R, 128MB RDRAM, Maxtor ATA/66 hard drive. Mixed-mode duplication tests performed "on-the-fly" without caching.

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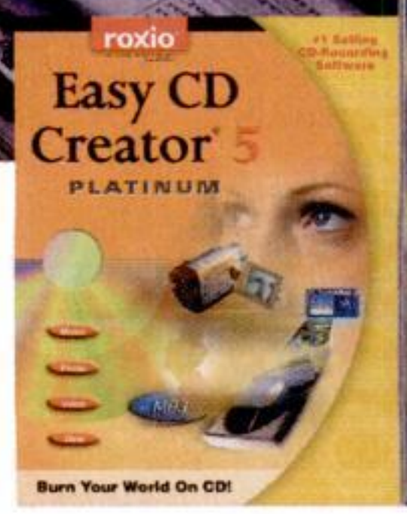

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Anatomy of an MP3 File

To master MP3 encoding, you must be intimately familiar with what makes MP3 files tick.

In 1999, "MP3" overtook "sex" as the most commonly searched-for word on popular Internet search engines. Clearly, the MP3 format has begun a digital music revolution, but what makes MP3 possible? The key technology is perceptual audio encoding, a form of lossy compression that allows you to compress file sizes of most types of audio by up to 90 percent. Without compression, every minute of CD-quality music requires about 10MB of disk space. But by using a perceptual encoding technique, as the MP3 format does, that same minute of audio can fit in 1MB or less of disk space, with no noticeable loss of quality.

How does audio encoding work? We'll give you the basics, then we'll give you the 411 on the panoply of competing codecs out now.

SQUEEZE ME, BABY

There are two basic categories of audio encoding: lossless and lossy. Lossless encoding works by replacing repetitive pieces of information with symbols and equations that take up less space but provide all the information needed to reconstruct an exact copy of the original.

Most people are familiar with lossless compression in the form of ZIP files. Because most kinds of data contain redundant information, replacing common occurrences (such as the word "the") in a file with a short numeric code makes the file much smaller. This is called Huffman encoding. Another method of lossless compression is known as Run Length Encoding (RLE), wherein repetitive sequences of the same value are replaced by a single code, followed by the number of times to repeat it. It's important to note that when you decompress a losslessly compressed file, the resulting file is identical to the original source file. Unfortunately, this isn't a great method for music, since most tunes don't contain much redundant information. If you tried to compress a WAV file using *WinZip*, you'd be lucky to reduce the size by 10 percent.

In contrast, lossy encoding works by discarding unnecessary and redundant information (sounds that most people can't hear). With lossy encoding, there is always some loss of fidelity, which becomes more noticeable as the file is further compressed. The goal is to produce a file in which the losses are not noticeable, or in which the losses are noticeable but not annoying. If a file using lossy compression is uncompressed, it will not be identical to the original file, as some information is irretrievably lost.

The highest compression ratio for lossless encoding is about 2 to 1, which means that a compressed file is one-half the size of the uncompressed original. Some forms of lossy encoding, however, can achieve compression ratios of up to 11 to 1 with quality virtually indistinguishable from the original. The quality of lossy encoding varies according to factors such as the bit rate (the transmission speed of binary coded data), the complexity of the music, and the quality of the encoding software. Even with the best lossy formats, there will be some people with very sensitive ears who are able to tell the difference between the original and the encoded file when listening to complex music on expensive hi-fi systems.

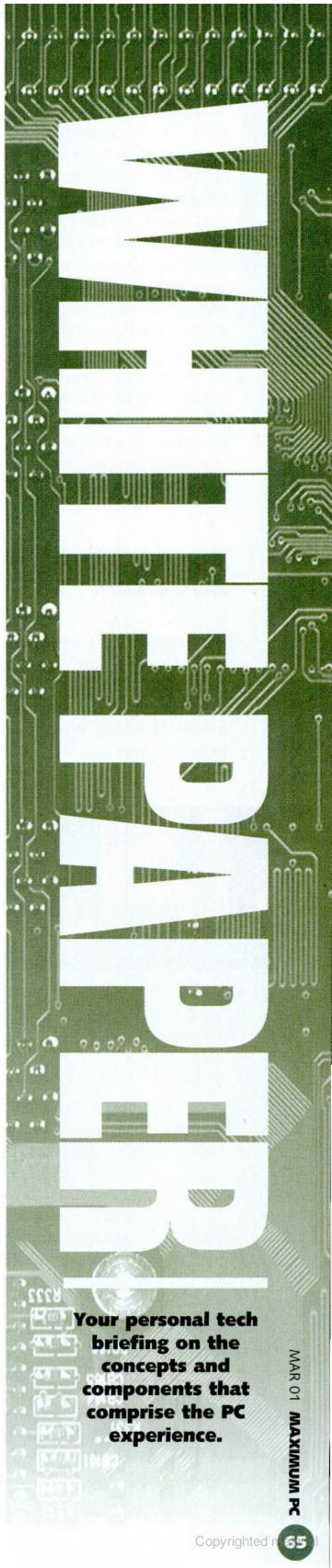
Most perceptual audio codecs first apply lossy compression, then use some form of lossless compression to minimize file sizes.

WHAT GOES AND WHAT STAYS?

Perceptual coding removes two types of sounds: those that the human ear isn't capable of registering and those that are masked by other sounds.

Your sense of hearing is more acute at some frequencies than others. Human hearing is most sensitive to the midrange frequencies between 1KHz and 4KHz. For that reason, most codecs leave the midranges more or less intact. The softest sound your ear is capable of perceiving at a given frequency is called the threshold of hearing. The threshold varies for sounds at different frequencies. For example, you may be able to hear a softer sound at a higher frequency than at a low, bassy frequency.

Most music (with the exception of some techno) consists of complex information that includes many different frequencies at the same



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time. What happens when multiple frequencies occur simultaneously?

When sounds are close in pitch, the louder sound drowns out the softer—like when your roommate yells at the referee on TV and you can't hear the commentator. This is known as frequency masking—softer sounds are "masked" by louder sounds that are close in pitch. Temporal masking occurs when sounds that follow a short, loud sound (such as a snare drum hit) can't be heard while your ears are recovering from the shock. This is most significant in the 20 milliseconds immediately following the loud sound. Since you can't hear these masked sounds, they can be removed from the signal without affecting the perceived quality.

KNOW YOUR ENCODER

Perceptual audio encoders, such as those used in the MP3 format, can compress audio files at a ratio of roughly 10 to 1 while still retaining very high quality. But one man's "CD quality" is another man's unlistenable crap. Who decides what data to throw away and what is "good enough"? You do, by choosing which codec and encoder to use and understanding the lossy compression process and its inherent tradeoffs. By learning how the settings in your particular encoding software affect the attributes of your data, you can control the quality and size of your compressed music. If you have an 80GB hard drive and a fast cable modem, you may be willing to go for higher quality and larger file sizes.

Encoding is the process of converting a stream of uncompressed digital audio to a compressed format. The mathematical algorithm used to encode music (and its opposite used to decode) is referred to as a codec, which is short for **co**de/**dec**ode.

Perceptual encoders must analyze the music signal to decide what goes and what stays. Mathematical functions, such as the Fast Fourier Transform (FFT) and Modified Discreet Cosine Transform (MDCT) are ways of converting a stream of audio data from the time domain (a stream of bits, e.g. 010101) to the frequency domain (such as a graph showing the distribution of lows, mids, and highs).

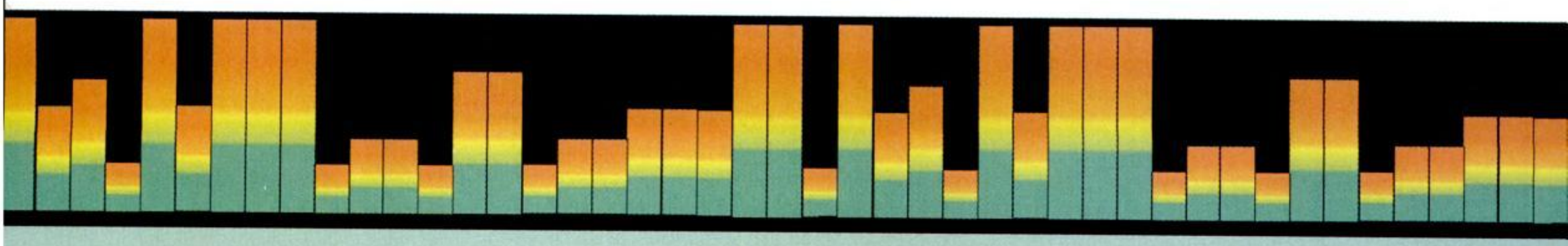
Stereo information is another factor in encoding. Music recorded in stereo consists of two distinct audio streams that give spatial references and depth to the music. Perceptual encoders have several ways of handling stereo information.

Simple stereo separately encodes each channel. Because a lot of information is common to both channels, this is not very efficient.

Joint stereo takes advantage of the common information by encoding the differences between the left and right channels into one stream of data and the common information into another. The decoder can then reconstruct the stereo signal perfectly, with no loss. This is also called middle/side (MS) stereo—it's the same method used in FM stereo broadcasts.

Intensity stereo encodes only the information that is important to perceiving a stereo image. Intensity stereo is the most efficient, but the stereo image can suffer at lower bit rates.

Apparently some codec developers believe that the music-loving populace has suffered hearing damage from listening to too much heavy metal, since some encoders throw out frequencies over 16KHz, which are still within the audible range for most people.



A LOOK AT COMPETING AUDIO FORMATS

MP3 might be a household term thanks to the past year's media blitz, but you should know that MP3s aren't the only type of digital audio. In fact, thanks to big record labels, there are more codecs now than ever.

Unfortunately, none of these formats are compatible with each other, but multiple formats will continue to be a fact of life for the foreseeable future. The kicker is that even formats based on open standards, such as MPEG, can be incompatible due to proprietary components such as digital rights management.

Most encoded audio formats are frame-based, which allows them to support the insertion of additional program information in the form of text, graphics, and other types of data. Audio files can include almost any type of data, such as copyright information, lyrics, album artwork, and even links to the artist's web site.

MPEG MANIA

The Moving Picture Experts Group (MPEG) committee is part of the International Standards Organization (ISO). Thanks to MPEG, we have standards such as the MPEG-2 video standard and MP3.

MP3 is short for MPEG Audio Layer III. Other MPEG layers include Layer I, which was designed for the Digital Compact Cassette (DCC), and Layer II (MP2), which is widely used within the broadcasting industry. Each layer uses the same basic structure and includes the features of the layers below it. Higher layers offer progressively better sound quality at comparable bit rates and require more processing power for decoding the audio.

Advanced Audio Coding (AAC) was developed under MPEG-2 and is sometimes referred to as MPEG NBC, because it is "Not Backwards Compatible" with MPEG layers I through III.

The AAC codec allows for finer control over what information is discarded during encoding. It adds techniques such as prediction (guessing what comes next) and uses a more flexible bit-stream structure to increase the amount of compression without sacrificing quality. The AAC codec is part of the standard for DVD Audio.

STRICTLY COMMERCIAL

Although MP3 and ACC are based on open standards, they are not entirely free. The Fraunhofer Institute and Thompson Consumer Electronics hold patents on MP3 technology and collect royalties from anyone who creates and distributes MP3 encoding programs—even if they give them away. The patent rights to AAC belong to

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CHOOSING THE BEST METHOD

Creating your own MP3s is a two-step process. The first is copying (or ripping) the uncompressed audio from the CD, followed by compressing (or encoding) the ripped audio into MP3. When you're compressing audio information, the single-most important setting you'll encounter is the bit rate. The bit rate expresses the amount of data, after compression, used to describe one second of the song. Naturally, a higher bit rate sounds better and results in fewer encoding errors. The bit rate for digital audio is expressed in thousands of bits per second (Kbps) and has a direct relation to the file size. File sizes for encoded audio can be calculated by multiplying the bit rate by the length in seconds. Files compressed at the same bit rate will be roughly equal in size, regardless of the codec used.

There are two competing techniques used in MP3 encoding that you should be aware of—constant bit rate and variable bit rate.

Constant bit rate (CBR) encoding records the entire song at the same bit rate. This means that the encoder uses the same number of bits each second—and thus the same amount of disk space—whether recording a section of silence or a complex passage of music. Constant bit rate encoding creates predictable file sizes.

Variable bit rate (VBR) is an option in most modern MP3 encoders that adjusts the number of bits available to the encoder depending on the complexity of the music. For example, a simple passage with just a vocalist and acoustic guitar needs fewer bits (and will take up less space) than a passage with a full orchestra.

In general, VBR will produce significantly better sound quality than CBR at a similar rate. VBR also helps maintain a more constant signal-to-noise ratio. The downside to VBR is that some older portable players and software will not properly report song lengths and elapsed times.

We recommend creating your MP3 files with VBR set to 76 percent (in software such as *MusicMatch*) to obtain a good balance of sound versus file size. We've found that files are only slightly larger using VBR, but sound much better. If you've encoded your tunes using VBR, some players, such as *Winamp*, show you the bit rate as the file is being played, so you can watch the bit rate jump from as low as 64Kbps in simple passages to more then 256Kbps in complex ones.

REALITY—WHAT A CONCEPT!

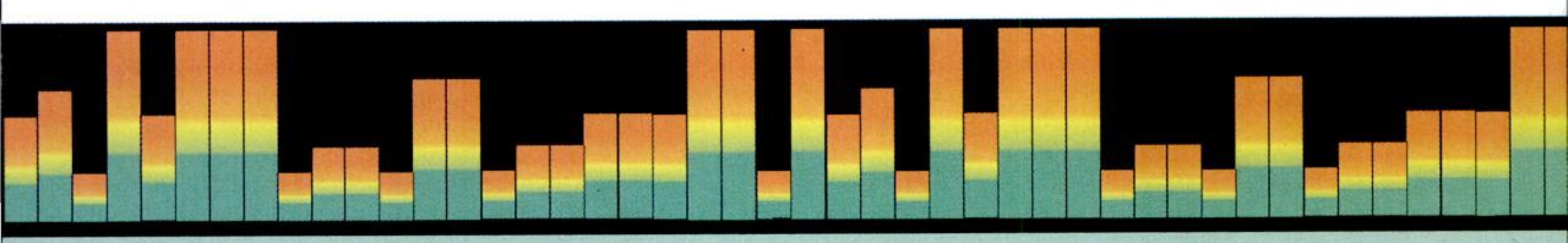
Artifacts are the most common flaws in encoded audio. Virtually all encoded audio exhibits some artifacts, especially at lower bit rates. Common artifacts are chirps, pre-echo, pumping, and loss of stereo imaging. Don't confuse compression artifacts with ripping defects, such as clicks, gaps, and phasing introduced in the copying process.

Commercially available encoders, such as *Xing* and *Xaudio*, are generally very good. Most of the modern encoders will produce acceptable sound that is relatively free of errors. Other than the specific format, (MP3, AAC, etc.) the bit rate will have the most impact on sound quality.

Since sound quality is very subjective, it's best to trust your own ears and not assume that a specific bit rate equals a certain quality.

—Marty Fries and Bruce Fries

Marty and Bruce are co-authors of *The MP3 and Internet Audio Handbook* (**www.MP3Handbook.com**).



AT&T, Dolby, Fraunhofer, and Sony, which have aggressively pursued anyone who has tried to release an AAC encoder without paying large, up-front licensing fees. AAC licensing is also much more restrictive than the licensing for MP3, with requirements that AAC encoded files include digital rights management features to "secure" the music and prevent unauthorized copying.

The following are some of the major competing formats to MP3:

- Real Audio was the first widely used format for listening to music over the Internet. It's used by many Internet radio stations and online music stores for streaming music in realtime over slow modem connections, but it's not a great format for high-quality downloadable music.

- Windows Media Audio (WMA) format is Microsoft's catch-up attempt to extend its software monopoly to digital music. Microsoft claims that WMA sounds more like the original CD than MP3, and uses only half the bandwidth. To "prove" this, Microsoft paid the National Software Testing Lab (NTSL) to conduct a test comparing WMA at 64Kbps with a now-outdated version of *MusicMatch Jukebox* at 128Kbps CBR using ordinary PC speakers in an office environment. Of course, your mileage may vary.

- AT&T's a2b music, Global Music's MP4, and Liquid Audio are all systems for music delivery that are based on AAC—and thus include schemes for copyright enforcement and royalty tracking.

- Ogg Vorbis is a high-quality, non-proprietary, patent-free, open source, compressed-audio format and streaming technology. Ogg Vorbis is still under development but is expected to offer the quality of AAC without all the nasty patents and licensing fees.

WELCOME TO THE REVOLUTION

Competing codecs and format wars will be around for years to come. MP3 may not be the most efficient format, but it isn't going away anytime soon (like DOS and cassette tapes) because lots of free and inexpensive software, hardware, and music are available *now*.

And MP3 can sound every bit as good as newer, less-open formats (such AAC and WMA)—though perhaps at the expense of disk space or bandwidth. But with disk space and bandwidth getting cheaper every day, that's becoming less of a problem. As the song says, "It's getting better all the time!"

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ASK THE DOCTOR

Symptom | Diagnosis | Cure

Even the burliest of PCs comes down with a bug every now and then. That's when you need to call The Doctor and get a diagnosis that'll have you up and running in no time. Send your symptoms to: **doctor@maximumpc.com**

This month:

- Windows Dual Booting
- Chipset IRQ Madness
- To SCSI or Not to SCSI
- Virtual Device Issues

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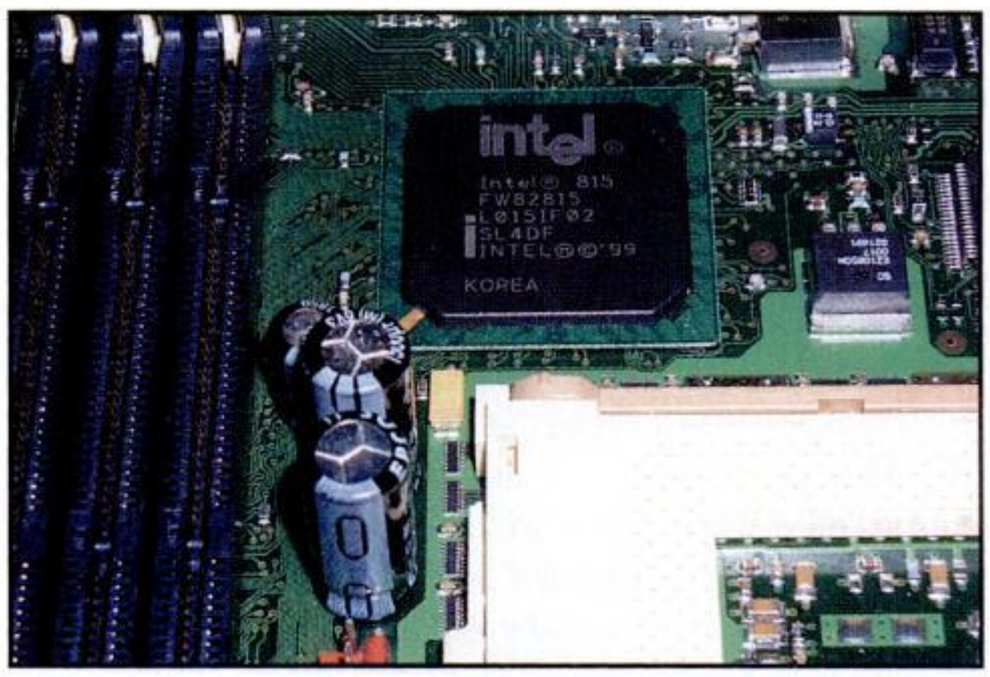
Windows Dual Booting

I'm getting ready to build my very own dream machine. It's a dual P-III 800MHz on an ABIT VP6 mobo with onboard RAID. I want to run both Win98 and Win2000 on it. I'm planning on putting Win98 on an old 8.4GB HD and then running Win2000 off two 46.1GB IBM Deskstars (in RAID 0). I'm just wondering what would be the easiest way to install both operating systems. I'm thinking about installing Win98 first (along with all of my hardware), and then installing Win2000 on the RAID drives after I get everything else all set up. Is this the best way to go? I know Win98 will not support SMP, but will it run fine even though I have dual procs?

—Dan



New chipsets don't have full Windows support. For this reason, don't forget to install chipset drivers, ASAP.

Your best strategy is to install Win98 first and then Win2000. However, you'll need to go into your PC's BIOS and set your boot order to boot from your RAID array after you've installed Win2000. That's because Win2000 will set up your boot loader on the drive it resides on—the RAID array. If you don't do this, only Win98 will boot up; Windows 2000 won't boot at all because the boot order will immediately go to the Win98 drive.

If you don't want to allow Win98 access to the RAID array, format the RAID array to NTFS; Win98 won't even see an NTFS partition. If you do this, however, you'll lose that 90GB of storage the RAID array will hold, and Win98 might get a little lonely with just an 8GB drive.

But why do you even need Windows 98 if you already have Windows 2000? Aside from a few games and DOS apps, Windows 2000 will run nearly everything you throw at it. Driver support is another issue, we admit. Some drivers are just fine in Win2000, but others aren't quite as polished as Win98 counterparts.

As for Win98 and SMP, when you're booted into Windows 98, the second processor will just be a heat source for the rest of your system. The proc will run, although Win98 just can't and won't use it. But the second proc won't hurt your system.

Chipset IRQ Madness

I have a Tyan Tiger133 motherboard with dual 800MHz Pentium IIIs, an Adaptec 39160, a Hercules 3DUltra videocard, Sound Blaster Live!, a Hollywood decoder, 3Com NIC, and a lot of hard drives, both SCSI and IDE. In Win2000, the machine keeps locking up when I start installing the cards. Each card is using the same IRQ. I reformatted the machine, chose F5 at the SCSI screen setup to choose HAL, and chose standard PC—and it still installs on IRQ 11. So, how did you get yours to work so easily?

—Keith

It looks like you've put your horse in front of your carriage, Keith. Anytime you install a new OS, always be sure that the chipset drivers are loaded before you do anything else. Install those drivers immediately. If you don't, the IRQ police will send you to the pokey without passing Go and without collecting $200.

"The IRQ police will send you to the pokey without passing Go and without collecting $200."

A fresh install of Windows won't detect which chipset is on your motherboard unless it's a fairly old chipset, in which case support is built into Windows. What happened in your case, Keith, was that you ended up installing your peripherals without installing the chipset drivers, and

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Windows didn't know what to do with the peripheral card because the drivers for the chipset help Windows determine what to do with the hardware put into the system. Only after installing chipset drivers should you start to install other hardware.

Even a faulty keyboard can bring Windows to a halt.

Sounds like a keyboard problem, Eve. VKD stands for Virtual Keyboard Device. If you've got another keyboard handy, pop that puppy in and see if that fixes it.

On some motherboards, that error message will be followed by a message stating "Press F1 (or equivalent key) for Setup" or "Press F2 (or equivalent key) to load defaults and continue." Your message locked up halfway through, so you may not even be able to see if your board can bypass the error. The only option you have is to change the keyboard to alleviate the problem. There are other virtual devices that can give your system fits. The best resource for finding more information about this type of problem is Microsoft's Knowledge Base at **http://search.support.microsoft.com**.

To SCSI or Not to SCSI

I'm in the planning stages of building a PC for video editing. I'd like to know if a large-capacity, 7,200rpm IDE hard drive would be just as good as a 10,000rpm SCSI drive for this purpose? I like SCSI speed but not SCSI complexity.

— JW Starks

Video editing used to require SCSI. Not so today. With the performance of IDE drives starting to reach and exceed that of SCSI drives (see our feature story on page 58), it really doesn't make a difference unless you're playing with extremely large video clips. What should be noted is that older 10,000rpm SCSI drives will be slapped around by newer 7,200rpm IDE drives in total throughput. That's because newer drives have more data packed onto each platter.

Because of this, the heads extract and transfer more data to the system with each rotation of the spindle on the drive. Each generation of hard drives increases throughput either by increasing spindle speed and/or increasing areal density—the amount of data packed onto each disk. Given the current performance of IDE drives, video editing won't be a problem.

> **"Older SCSI drives will be slapped around by newer IDE drives in total throughput."**

Virtual Device Issues

I've got a problem with my computer when booting Windows 98SE. Halfway through the bootup process, the machine gives an error stating "While initializing device VKD: Windows protection error. You need to restart your computer." When I reboot, the machine does the same exact thing, but at times it only gets halfway through the message before total-system lockup. What's going on in my system?

—Eve

Forum Beefs

I was reading the overclocking question in the February issue. What surprised me is that you never mentioned the *Maximum PC* Forum as being a good source of overclocking information. There are many of us there who overclock and would help readers out in their endeavor to push their procs to the moon and back, if that's what they want. Maybe next time you could give us a plug. We have many members that can help with many other hardware/software related problems as well.

— [PC][O/C][Abit Zealot]LondoJowo

Consider yourself plugged, Londo Jowo. We know the Forum is an excellent place for all sorts of hardcore tech info. Now the rest of our readers do, too. For those who don't know where our online Forum is, head over to **www.delphi.com/maxcommport** to discover more hardcore tech info.

Clock Problems

In January's issue, Adam M. had a problem with his PC's clock losing time and you had no easy remedy. Well there is a very easy fix, a little freeware utility that syncs the PC clock to one of the atomic clocks on the Internet. It's called Dimension 4 and can be found at **http://thinkman.com/dimension4**.

—Douglas Howard

We had many people send in different utilities to keep your clock running correctly. Besides the Dimension 4 program, there's the Atomic Clock at **www.atomtime.com** available for download. Other readers remarked that a networked system would have a Server Time synchronization problem. The truth is, all of these suggestions may have helped Adam, but the culprit could have been an underlying problem. Not all clock problems are on networked PCs, so the info we gave was valid, but perhaps we weren't as specific as we could have been in answering Adam.

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REVIEWS

Paying the Best Price

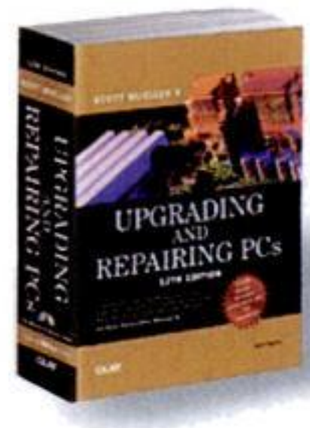
We've received some questions regarding the prices we publish in product reviews, so it's time to set the record straight. In past reviews, we've quoted the manufacturers' suggested retail price (MSRP) to err on the side of caution. Sure, we could quote lower "street prices" as well as some of the rock-bottom prices we see bandied about online, but we think it's better to present worst-case scenarios. After all, if you go into a store expecting to pay the MSRP but find your item at a reduced price, your spirits can only be lifted. And let's face it: Not everyone has the savvy to find the best deals available, and we don't want to lead these people astray.

So please take our published prices with a grain of salt. Almost every product featured in the magazine can be found for less than the MSRP. You just have to know where to look.

—JOSH NOREM, REVIEWS EDITOR

BOOK OF THE MONTH:

UPGRADING AND REPAIRING PCs



Skeptics may say we're recommending this book only because a quote by Reviews Editor Josh Norem appears on the front cover—and they're partially correct. Look, Ma, I'm on the cover of a big book! Shameless plugs aside, this tome by Scott Mueller contains approximately 10 pounds worth of PC knowledge. It's all highly technical, yet wonderfully easy to understand. We doubt that even know-it-alls like Gordon will be able to finish *Upgrading and Repairing PCs* without learning something new. Its ISBN is 0-7897-2303-4.

Lara Croft Model: Tchotchke or Exhibit A?

The PR team from Eidos Interactive recently gave us a lovely "cold cast" sculpture of Lara Croft, she of the ample, uh, "presence." We placed the model in our work area, where it was met with immediate disapproval from our magazine's Generalissimo. We eventually reached a compromise, but everyone involved is still shell-shocked over what has became known around the office as "Boobiegate."

Being avid gamers, we proudly displayed the Lara Croft sculpture for all to see. Due to its top-heavy design, metal posts in Lara's feet prevent the model from toppling ass-over-teakettle.

Upon spotting the model, Herr Phillips impounded the sculpture and lectured us on the finer points of sexual harassment policy: "This could constitute a hostile work environment!"

Not wanting to lose our lovely Lara, we promptly brought her up to code.

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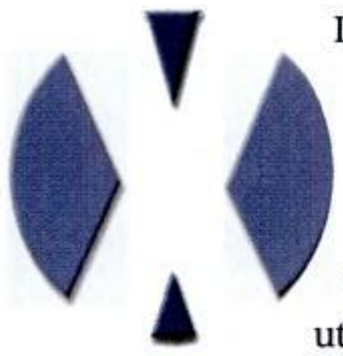
A behind-the-scenes look at the Maximum PC Lab and the gearheads who work in it.

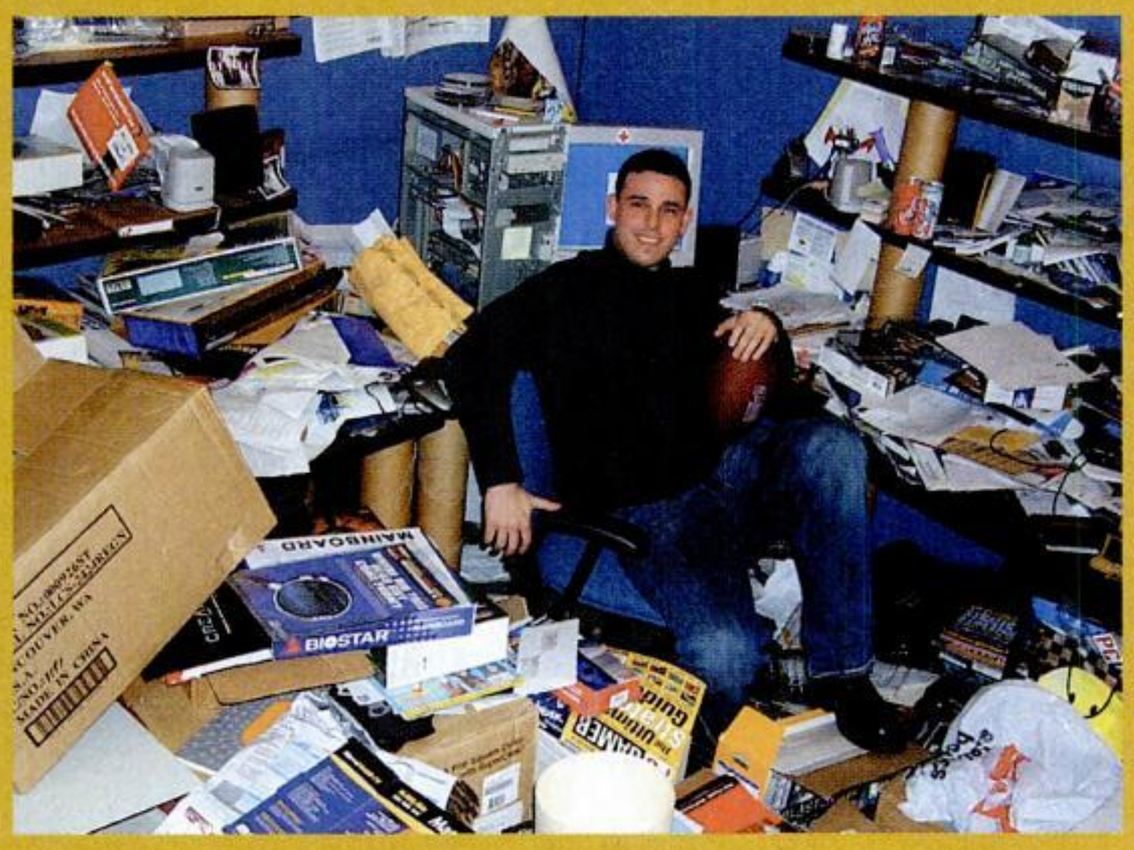
RIGHTEOUS LINK: ANALOGX.COM



If you don't want to hack your Registry in order to get Windows to stop asking you for the install CD, visit **www.analogx.com**. In addition to the nifty *banishCD* utility, the site offers oodles of free utilities that do everything from optimizing memory settings to monitoring traffic across your net connection. Our favorite download is a *Winamp* plug-in that lets you remove vocals from MP3s for karaoke madness!

GREG VEDERMAN: A REAL-WORLD PIGPEN

This is Greg Vederman, hardware editor for one of our sister magazines, *PC Gamer*. We present this image of Greg in his natural work environment for one reason and one reason only—to embarrass him. We thought Gordon's desk was a pigsty, but Gordo can't hold a candle to the Vede's fire-code-flouting Desk of Shame. This picture is an actual photo of Greg's work area. It was not doctored or staged in any way.



Lemon of the Month

Senior Editor Gordon Ung

Gordo used to arrive at work on-time and well-dressed. Lately, however, he's been rolling in at 10:30 a.m. and looking like he just got out of bed. Is Gordo just temporarily slacking, or has he lost the will to contribute to a civilized world? Give him a pep talk at **gung@maximumpc.com**.

CHECK IT OUT

Online

www.maximumpc.com

Benchmarking: Full Disclosure

Visit **www.maximumpc.com/benchmarking** for the complete lowdown on *Maximum PC*'s benchmarking strategies.

42 PRODUCTS REVIEWED!

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Hardware photography by **AARON LAUER**

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Polywell Poly 850GB-1500

POLYWELL P4 PC PACKS A PUNCH

This P4 rig has beauty and brawn in spades.

Every system we receive from Polywell is stuffed with a nice complement of top-notch hardware, but for some reason, the company never adds the attention to detail or the full arsenal of components that would truly put its systems in the top tier. This P4-equipped box is no different. It offers record-breaking gaming performance and an absolutely stunning brushed aluminum case, yet it also includes several components that we wouldn't wish upon our worst enemies.

We don't mind the SoundBlaster Live! soundcard, and we're actually titillated by the Annihilator II Ultra videocard, but the 8/4/32 Creative Labs CD-RW drive is a second-gen knock-off, and listening to the Creative Labs PCWorks speakers is sado-masochism, pure and simple. Maybe Polywell is simply helping Creative Labs clear out its surplus stock, or perhaps Polywell goes with older peripherals to budget for top-of-the-line primary parts. Whatever the case, we wish Polywell would send us a balls-to-the-wall, no-compromises, loaded-like-Axl Rose Super PC. Perhaps someday we'll receive such a rig, but possibly not as long as Creative Labs is the supplier of its CD-RW drives and speakers. With a CD-RW drive from TDK or Plextor and Klipsch ProMedia speakers, this system would be a serious power broker.

Despite these egregious hardware violations, the Poly's combination of a 1.5GHz Pentium 4 and GeForce2 Ultra make this PC a gaming god-box. The Polywell pulverized all previous systems in Direct3D testing and even spanked last month's Perfect 10 system from Voodoo by 20fps. It also beat previously reviewed P4 machines from Compaq and Dell by a substantial margin.

The Polywell system also made a mockery of our *Quake III* benchmark with its score of 120fps. Not long ago, 100fps in *Quake III* was a mere pipe dream, but with the arrival of the P4 and GeForce2 Ultra, that barrier has been blown to smithereens. In fact, the only factor hindering this rig's gaming prowess is the inclusion of the Cambridge Soundworks PCWorks speakers, which are such an easy target we don't even enjoy picking on them anymore.

The only benchmark in which the Polywell came up short was our system-wide *SYSmark* gauntlet. This PC-punisher executes a script within real world applications such as *Bryce 4* and Microsoft Windows *Media Encoder 4*, then averages a single score based on how long it took the system to complete the scripts. The Polywell's score of 188 falls smack-dab in the middle of scores posted by the P4 systems tested in January, splitting the Dell score of 206 and the Compaq's 172 right down the middle. As mentioned previously, however, the Polywell made gimps of both those systems in gaming tests, so go figure.

Of course, no gaming machine is complete without a tricked-out, custom-looking case, and the 850GB comes wrapped in one of the tastiest cases we've ever seen. The 10-bay, brushed aluminum ATX mid-tower is très classy, easily accessible, and a pleasure to ogle at and run your fingers along (maybe we need to get out more). It also offers enough cooling to satiate a penguin, with two 80mm fans sucking air inward from the lower front and blowing it up to an 80mm fan nestled below the 350W power supply. And get this, the power supply has a 120mm fan on its belly, sucking air into the gaping maw of another 80mm fan that blows air out of the case. Brrrrrr!

Another component that has become a recent staple of gaming machines is IDE RAID, and the Polywell keeps up with the Joneses in this department. Two 30GB IBM 75GXP drives are connected to a 3Ware RAID controller, offering 36MB/sec average read speeds.

In the final tally, this Polywell P4 box is the most mouth-watering machine we've ever seen from Polywell. It's got a few unseemly components that keep it from Kick Ass status, but still, it's a machine we'd be proud to call our own.

—Josh Norem

PLUSES
- Full-speed gaming
- Case is a knockout
- Well-thought-out cooling design

MINUSES
- 8x CD-RW drive is aged
- Cambridge Soundworks speakers are torture

UNDER THE HOOD

THE BRAINS	
CPU	1.5GHz Intel Pentium 4
L2 cache	256K full speed
RAM	128MB PC800 RDRAM
Motherboard	Intel D850GB
Drive bays	Four 5.25-inch (two free), six 3.5-inch (three free)
I/O ports	Two PS/2 | Two USB | One serial | One parallel | Digital out
DISPLAY	
Video	Creative Labs Annihilator II GeForce2 Ultra 64MB DDR SDRAM
STORAGE	
Hard drive	60GB IBM 75GXP RAID array (two drives, RAID 0), 7,200rpm, ATA/100
DVD	Toshiba SD-M1402 12x
CD-RW	Creative Labs 8/4/32
Removable	Floppy
Raid	3Ware 6200 two-port IDE Controller
NETWORKING	
NIC	Intel 100Pro 10/100 EthExpPCI
SOUND	
Soundcard	Creative Labs SoundBlaster Live! Value
Speakers	Creative Labs PCWorks FourPointSurround 4.1
THE BUNDLE	
Windows 98 (ME, NT available) | *Nero 4.0* | *Cyberlink PowerDVD*	

BOOT 1:23 DOWN 0:02

TEST	ZERO	SYSTEM	RESULTS (%)	RANK
SYSmark	174	188	8.0	Unseeded
Hard drive	20.2MB/sec	35.9MB/sec	77.0	3rd Seed
CD-ROM	26x	27.6x	6.0	Unseeded
Photoshop	170sec	109sec	41.0	2nd Seed
Direct3D	38fps	105.7fps	176.0+	LEADER
OpenGL	34.4fps	120.1fps	248.0+	2nd Seed

Full benchmarking details at www.maximumpc.com/benchmarking/index.html.

MAXIMUM PC VERDICT 9

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www.polywell.com
800.900.5836

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EXPANSION NOTES

Despite this PC's generous payload, two PCI slots remain empty. There are also five free drive bays, and the wide-body case means upgrades will only be painful for your wallet.

EXPANSION MAP

AGP:	Videocard
PCI:	Free
PCI:	RAID
PCI:	NIC
PCI:	Soundcard
PCI:	Free
CNR:	Free

CASE | COOLING | POWER

CASE

Polywell calls this 10-bay, brushed aluminum case the "Platinum." Officials said they ordered it "from Korea." It features a wide-body design, with every door, slot, and removable unit attached with thumbscrews.

COOLING

Three 80mm fans; power supply features one 120mm fan on its underside, one 80mm fan on its rear. CPU cooled by fan/heatsink.

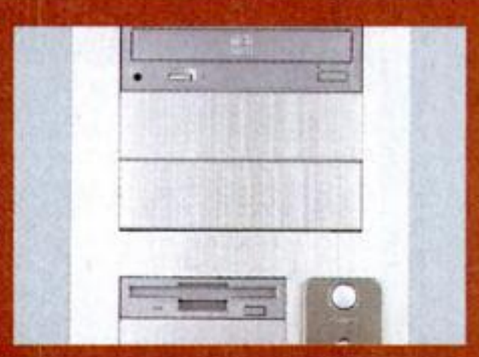
POWER

350W ATX power supply with twin fans.

Under my thumb. We love easy access, and we've fallen hard for this case's tool-less design. Everything is attached with thumbscrews, and you can even remove the power supply by undoing two screws.

Belly of the beast. This 350W power supply is kept frigid by the 120mm fan on its tummy. Once air enters the vortex, it's pushed along by another 80mm fan on the power supply's backside.

PC prophylactic. Cases with sharp metal edges make us grouchy, so imagine how stoked we were to see rubber housing along the drive bays to prevent cuts and scratches. We were, like, totally stoked about that.



Metal monster. Don't mind the drool marks we left on this case's brushed aluminum exterior. This sexy 10-bay thang is very light, extremely sturdy, and best described as "wow."

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annoyances, the Asus CUSL2-C would make a spectacular addition to any PC.

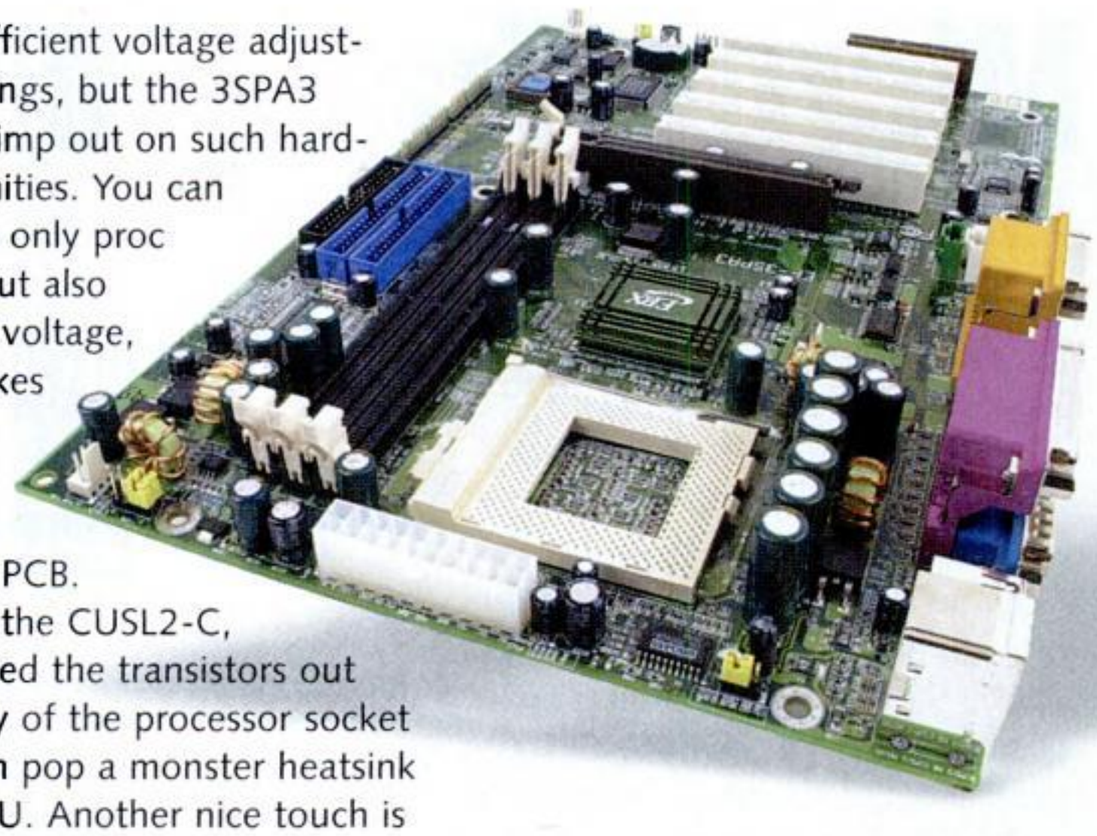
EPoX 3SPA3

Though not as well known as Asus, EPoX produces fine motherboards, and the 3SPA3 is no exception.

Just like the Asus CUSL2-C, the 3SPA3 integrates onboard ATA/100, AGP 4x, and overclocking options into a well-laid-out PCB. From the power supply connector to the front-mounted connector panel for the case wires, the layout is exquisite. The one immediately apparent drawback is the lack of a sixth PCI slot.

And, yes, EPoX offers overclocking options matched only by Asus and Abit. Most motherboards suffer from insufficient voltage adjustment settings, but the 3SPA3 doesn't wimp out on such hardcore amenities. You can tweak not only proc voltage, but also videocard voltage, which makes for easier overclocking across the entire PCB. Unlike on the CUSL2-C, EPoX moved the transistors out of the way of the processor socket so you can pop a monster heatsink on the CPU. Another nice touch is the AGP locking mechanism that keeps your videocard in place.

While Asus omits the integrated sound inherent in the 815EP, EPoX chose to keep it. We've said it before and we'll say it again: Don't use onboard sound. Not only does it blow chunks in comparison to add-in soundcards, such as the Sound Blaster Live!, but it also sucks life out of the processor by using it to do the sound chores.



Even with the lack of a sixth PCI slot, EPoX has crafted a fine board.

Our benchmarks weren't entirely kind to the 3SPA3. The EPoX board edged Asus by a single point in *SYSmark 2000*, and walloped the Asus in our *Photoshop* script by 30 seconds. In *3DMark 2000*, EPoX stymied the Asus board by 1fps. However, EPoX lost to the Asus board in our *Quake III* test, as well as in all of our Sisoft *Sandra* bandwidth tests.

The excellent layout of the board, along with its sweet voltage settings, garner almost enough kudos for us to overlook the low *Sandra* scores. EPoX has made a fine board that holds its own against the best.

—Scott Tarr

EPOX

PLUSES
Nice layout
Yummy voltage overclocking

MINUSES
Lack of sixth PCI slot

MYLEX

PLUSES
Battery Backup Module
Multiple RAID levels

MINUSES
Slow scores in comparison to ATA RAID
Expensive to enter the SCSI RAID world

MYLEX ACCELERAID 352

The AcceleRAID 352 is a dual-channel, full-length SCSI RAID card that's equipped with 64MB of ECC SDRAM pumping an Intel i960RN RAID processor. The 352 offers a Battery Backup Module (BBM) that monitors the write-back cache on the controller and provides from 60 to 168 hours of battery life to the cache in case of a power outage. The battery level can be checked from within the bundled Global Array Manager software. The GAM software also allows you to reconfigure RAID arrays from within Windows for fine-tuning and monitor your RAID array after you have it up and running.

We tested the card with two Quantum SCSI hard drives and were perplexed at the wimpy throughput.

Mylex's AcceleRAID 352 will set you back a fortune, but for servers, it's worth it.

So, just for kicks, we also tested an Adaptec 3200S RAID controller with the two Quantum drives, and the Adaptec card didn't fare any better than the Mylex. The Mylex's maximum throughput of 35MB/sec just doesn't compare to that of two IBM 75GXP IDE hard drives and an ATA RAID card. However, the Mylex card can handle twice the transactions per second—such is the benefit of SCSI (see our SCSI vs. IDE showdown on page 58). For database and server duties, ATA RAID won't cut it until IBM makes its IDE RAID technology available. Until then, SCSI will continue to dominate in the server/ database arena.

	MYLEX ACCELERAID 352
RAID levels supported	0, 1, 3, 5, 01, 30, and 50
Quake III	
Timedemo 1	87.9fps
HD TACH	
Avg. read speed (MB/sec)	28.5
Random access time (ms)	7.4
CPU utilization (%)	5.7
IOMETER	
Max. read speed (MB/sec)[1]	35.52
Random access test (tps)[2]	211.70
CPU utilization (%)	2.42

Notes: Tests bed: Dell 733MHz Pentium III with 128MB RDRAM, two Quantum Atlas 10K II Ultra/160 drives, 3D Prophet II 64MB DDR SDRAM. [1]Performs 64K sequential reads across entire disk. [2]Performs 2K random reads (67%) and writes (33%) across entire disk to indicate typical database workload. Score reported in transactions per sec (tps).

ASUS CUSL2-C 9
$130 | Asus
www.asus.com.tw | 510.739.3777

EPOX 3SPA3 9
$110 | Epox
www.epox.com | 714.680.0568

MYLEX ACCELERAID 352 7
$995 with 32MB ECC SDRAM,
$1,295 with 64MB ECC SDRAM
Mylex | www.mylex.com
800.332.2222

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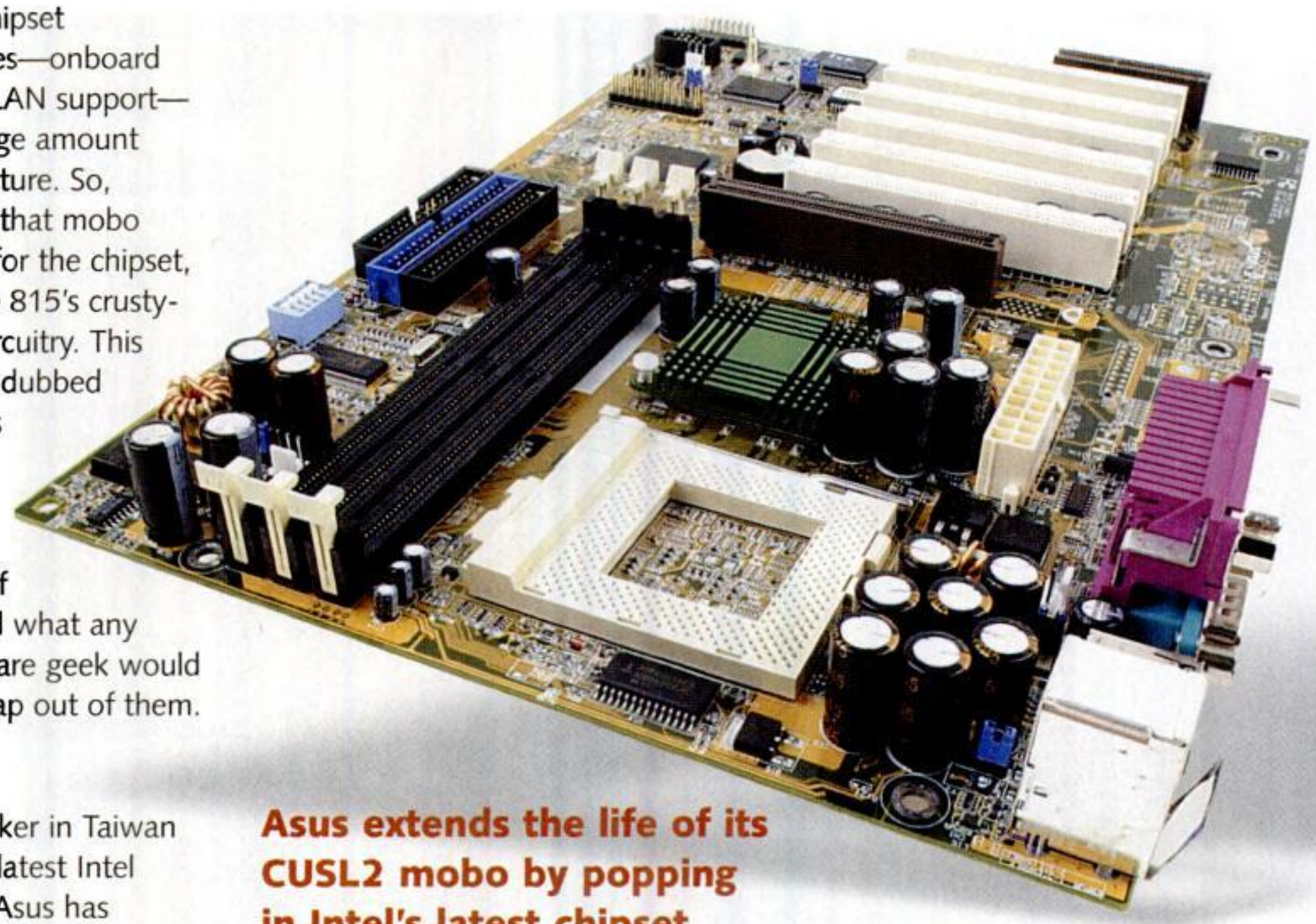
815 Mobos: Better than Ever

LATEST BOARDS LACK VIDEO, BUT ARE A SOUND VALUE

Because Intel's 815 chipset packs so many goodies—onboard graphics, audio, and LAN support—it costs a relatively large amount of money to manufacture. So, to lessen the amount that mobo vendors have to pay for the chipset, Intel has removed the 815's crusty-fusty i752 graphics circuitry. This updated 815 chipset, dubbed the 815EP, uses Intel's newest ICH2 controller hub to anchor the chipset. We got our hands on a pair of 815EP mobos and did what any self-respecting hardware geek would do—we tested the crap out of them.



Asus extends the life of its CUSL2 mobo by popping in Intel's latest chipset.

ASUS

PLUSES
Overclocking options up the yin-yang
Extra USB port added

MINUSES
Capacitors too close to socket

ASUS CUSL2-C

The largest mobo maker in Taiwan isn't about to let the latest Intel chipset go to waste. Asus has updated its CUSL2—which is based on the vanilla 815—to the CUSL2-C. And this new board isn't anything to sneeze at.

Besides the new core-logic chipset, the only real difference between the CUSL2 and the CUSL2-C is the absence of the AGP Pro slot, which isn't a big deal unless you're using super-high-end video-cards. The board includes support for ATA/100, AGP 4x, and mondo-overclocking options. Overclocking goodness starts at a "frontside bus to memory-speed ratio" control and doesn't stop until you've pushed your proc of choice beyond all recommended tolerances. An Award BIOS automatically senses what proc you have installed and gives you all the FSB options available for that proc. Voltage settings graduate in 0.05v increments all the way up to 1.95v.

Asus removed the onboard sound capabilities of the 815EP chipset. While this isn't bad, per se, it forces vendors and consumers to look elsewhere for their sound options. In this case, it's actually a good thing—the sound that Intel packed into the 815EP can easily be improved upon. Asus even adds two extra USB ports to the board.

During testing, the Asus board fared incredibly well in nearly all of our benchmarks. In our *Quake III* test, the Asus mobo beat out the EPoX board by over 3fps, and, in the Sisoft *Sandra* tests, Asus swept all categories. However, the Asus board did struggle with our *Photoshop* script. It lost to the EPoX board by a monstrous margin of 30 seconds!

The only chink in the CUSL2-C's armor is that transistors are placed too close to the processor socket, making the installation of some heatsinks (such as Thermaltake's Golden Orb) difficult. Serial port fanatics might also have a beef—there's only one port. Aside from these minor

MODEL	ASUS CUSL2-C	EPOX 3SPA3
Chipset	Intel 815EP	Intel 815EP
Supported processors	Socket 370 Intel processors	Socket 370 Intel processors
Expansion slots	1 AGP/6 PCI/1 CNR	1 AGP/5 PCI/1 CNR
Memory support	3 DIMMs for max of 512MB PC100 or PC133 SDRAM	3 DIMMs for max of 512MB PC100 or PC133 SDRAM
Ports	ATA/100/1 serial/ 1 parallel/4 USB	ATA/100/2 serial/ 1 parallel/2 USB
Overclocking rating	Excellent	Excellent

BENCHMARKS	ASUS CUSL2-C	EPOX 3SPA3
Quake III Timedemo 1	**62.4**	58.9
SYSmark 2000	122	**123**
Sisoft *Sandra* MIPS	**1896**	1879
Sisoft *Sandra* MFLOPS	**940**	932
Sisoft *Sandra* Streaming Integer	**253MB/sec**	244MB/sec
Sisoft *Sandra* Streaming FPU	**280MB/sec**	271MB/sec
3DMark 2000	41.2fps	**42.5fps**
Photoshop 5.5	3:44	**3:14**

Notes: Best scores are bolded. Settings for *Quake III Arena*: 1024x768, 32-bit color, trilinear filtering, maximum textures, 32-bit textures, Demo 1. Test bed: Windows 98 SE, Seagate Barracuda ATA/100, 700MHz Celeron PPGA, Elsa Erazor X2 DDR GeForce, 128 MB PC133 CAS2 SDRAM. Compatibility equipment: 3Com 3C905B 10/100 NIC, Diamond 12MB Voodoo2, Sound Blaster Live! X-Gamer, Adaptec 2940U2W, Logitech USB Mouse, Logitech/Storm USB Scanner.

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Micron TransPort GX+

A BRONZE MEDAL NOTEBOOK

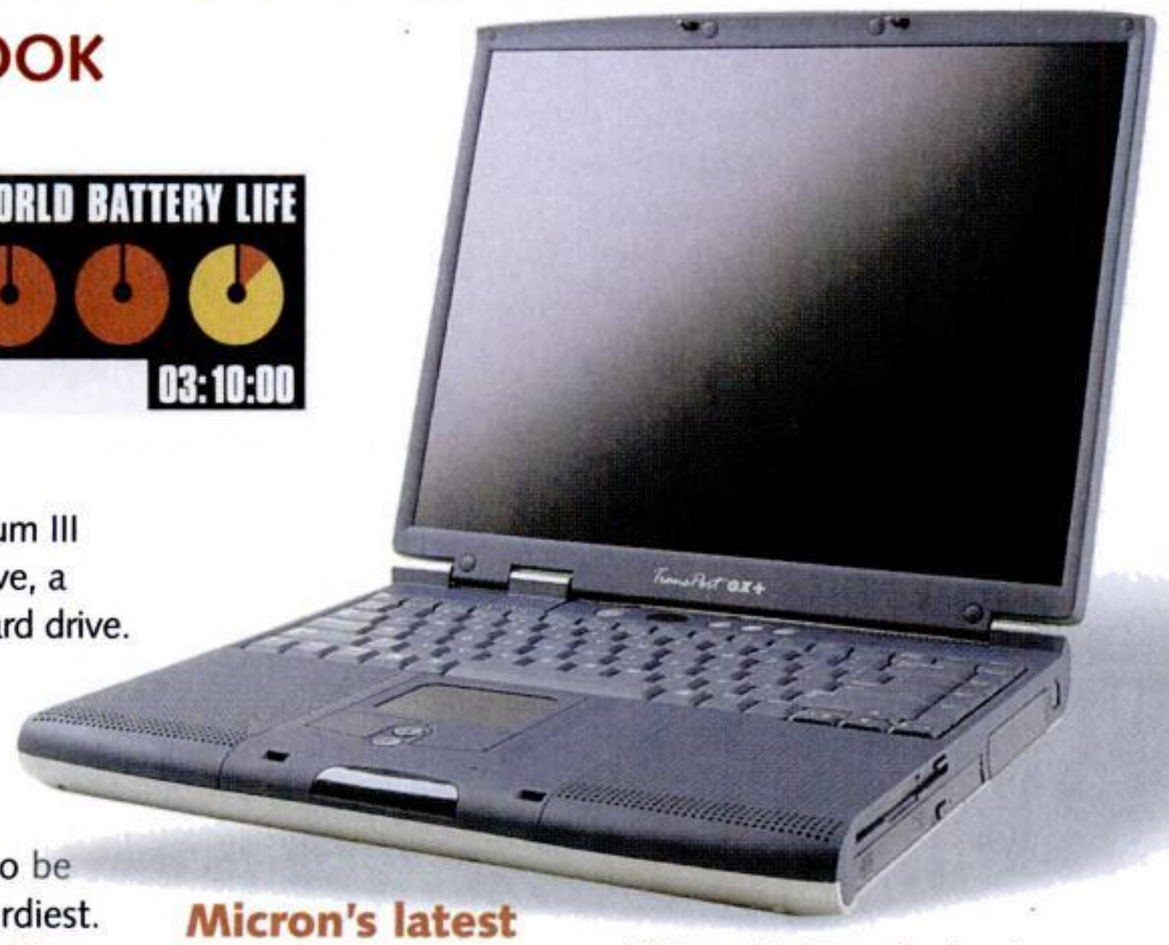
PLUSES
- Top-tier performance
- Feels solid
- Rubbery, non-slip coating

MINUSES
- Savage IX graphics
- Two full SO-DIMM slots
- Old-school BX chipset

Micron's TransPort GX+ pushes the envelope of how much can be stuffed into a notebook and still remain portable. Like the pair of bad-ass notebooks we reviewed in December, the TransPort GX+ easily matches wits with power desktops of just a year ago.

Peep the features: It has an 850/700MHz Pentium III SpeedStep processor, an 8x Toshiba DVD-ROM drive, a crisp and bright 15-inch TFT screen, and a 20GB hard drive.

The GX+ is a pleasure to touch. The face and sides feature a rubberized finish that makes the unit less prone to slippage. Of the notebooks we've checked out, the TransPort GX+ appears to be among the sturdiest. There's no creaking or squeaking when moving or using the notebook. One useful feature is an e-mail light that notifies you of a waiting message (it even works when the lid is shut). With the 15-inch screen, there's a slight overhang on the sides, but it's hardly noticeable.



Micron's latest TransPort gives desktop PCs built a year ago a run for their money.

The TransPort's performance is just a tick slower than that of the cutting-edge desktop replacements we reviewed in December. Interestingly, Micron opted to use the aging 440BX chipset rather than the newer 815 chipset found in the Dell Inspiron 8100. Although the TransPort lost to the Dell in most tests, its performance was good enough to put it in the top three in every non-gaming benchmark.

Where the TransPort got smoked was in gaming tests. The unit's 16MB S3 Savage IX simply can't compare to ATI's 32MB Mobility M4.

We were a little concerned about the use of the S3 chipset because of S3's withdrawal from the market, but Micron officials assured us that S3 is still alive and kicking, and driver updates will continue.

The TransPort's 3D graphics make it a second contender for die-hard gamers. Still, the burly Pentium III and Savage will suffice for games that don't require massive polygon computations and texture rendering. And besides, how many people play *Quake III* on their laptops (not counting our tech editor, Will)?

In addition to shortcuts in the graphics department, Micron cut a few other amenities to hit a manageable price. The IBM 20GB Travelstar hard drive is spacious enough, but it runs at only 4,200rpm. The Dell Inspiron reviewed in December came with an IBM drive, but it was bigger (32GB) and faster (5,400rpm). A second semi-faux pas is that Micron fitted its unit with two 64MB CAS2 SO-DIMM modules, leaving no free slots for future memory upgrades. Why fill both slots? Micron says there are a couple of reasons. First, it's well known that splitting memory into multiple banks nets you a bit more speed in memory access. Second, the two-module strategy costs less. If you have plans to move beyond 128MB, you should request that your unit come with a single 128MB SO-DIMM.

All in all, the TransPort GX+ is a fairly solid notebook. We would have liked more bay options (the Inspiron can run both a DVD-ROM drive and a CD-RW drive, or two batteries simultaneously), but Micron's latest effort is a damn fine contender nonetheless.

—Gordon Mah Ung

UNDER THE HOOD

THE BRAINS

CPU	Intel Mobile Pentium III SpeedStep 850MHz/700MHz
RAM	128MB PC100 SDRAM
I/O ports	Dual Cardbus PC card slots I VGA I Composite video out I Parallel I Serial One USB 1.0 port I PS/2 keyboard and mouse port Mic-in I Line-in I Headphone I IrDA docking station
Modem	3Com V.90 in Mini PCI slot
LAN	10/100 3COM LAN in Mini PCI slot

DISPLAY

Videochip	S3 Savage IX with 16MB of SDRAM
Display	15-inch SXGA+
Max res	1400x1050

STORAGE

Hard drive	IBM Travelstar 20GB 4,200 DJSA-220
CD-ROM	Toshiba 24x

SOUND

Sound	Audio chip ESS-1980+1921

TIPPING THE SCALES

Lap weight	7.3 lbs.
Carry weight	8.0 lbs.

BOOT 0:49 DOWN 0:18

TEST	ZERO	SYSTEM	RESULTS (%)	RANK
SYSmark	105	155	47.6	3rd Seed
Hard drive	11.4MB/sec	13.5MB/sec	18.4	3rd Seed
CD-ROM	15.5x	16.5x	1.1	3rd Seed
Photoshop	240sec	153sec	36.2	2nd Seed
Direct3D	14.4fps	16.3fps	13.0	3rd Seed
OpenGL	18.8fps	27.1fps	44.0	3rd Seed

Full benchmarking details at www.maximumpc.com/benchmarking/index.html

MAXIMUM PC VERDICT 8

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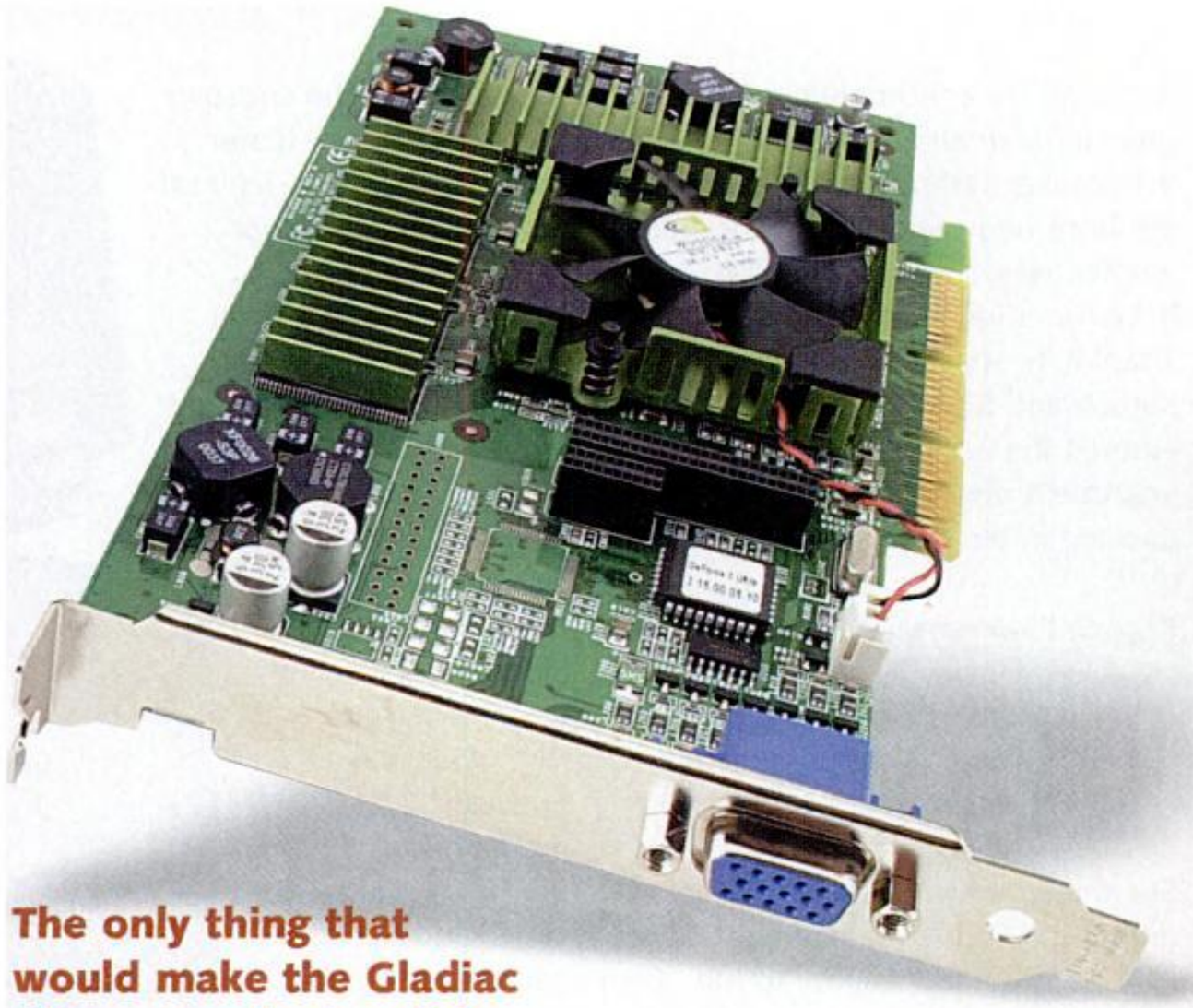
Elsa Gladiac Ultra

EVEN MORE ULTRA THAN OTHER ULTRAS



The only thing that would make the Gladiac Ultra yummier is a thin candy shell... Yummmm.

We've seen boatloads of GeForce2 Ultra-based cards, so when we received the Elsa Gladiac Ultra, our initial response was "whoop-dee-frickin'-doo." Elsa, however, has managed to surprise us with a card that not only packs the punch of a GeForce2 Ultra, but also contains a pair of Revelator shutter glasses—geeky specs that add stereo-3D visuals to games.

On the surface, the Gladiac is basically the same as every other Ultra card we've played with. Its core runs at a peppy 250MHz and feeds blazing-fast 230MHz DDR SDRAM. This combo gives you the fastest gaming experience money can buy. In other words, be sure your keyboard is waterproof because the Gladiac will have you drooling.

How does the Gladiac provide this level of speed? Naturally, it includes all the benefits of the Ultra chipset—a second generation T&L engine and four pixel pipelines capable of delivering an astounding 1 billion pixels per second. This is more than enough horsepower for any game that's currently available and should serve you well into 2002.

Naturally, the Gladiac also shares the central fault of other GeForce2 Ultra-based cards. Compared to ATI Radeon boards, the Gladiac's 3D image quality leaves a bit to be desired (texture-compression artifacts crop up in games based on the *Quake* engines), although this has been improved in the most recent driver releases.

Elsa brings more to the table with its Ultra card than do other vendors. The card's monitor database, which includes settings for almost any monitor imaginable, really smacks the monkey's ass, and the Revelators are cooler than a Ferrari. Well, maybe not *that* cool, but they're still pretty damn cool.

The Revelators do have one unfortunate side effect: After playing games for an hour or so, the glasses cause headaches in most anyone who wears them. This makes the Revelators a cool novelty, but a novelty nonetheless.

If you want to give the Revelators a spin and feel that you need a GeForce2 Ultra-based card, Elsa's got your number.

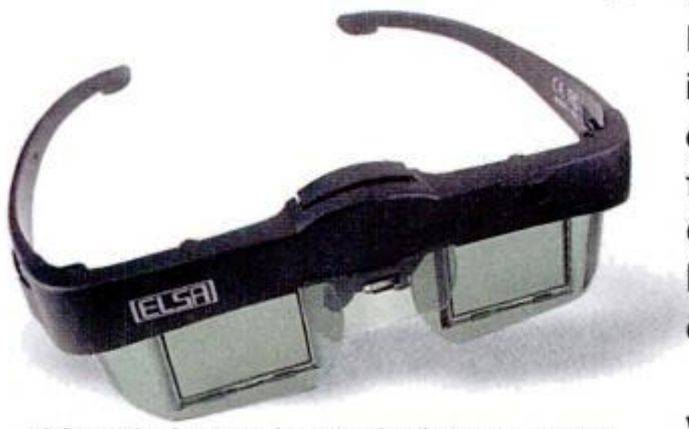
—Will Smith

PLUSES
- Revelators are very cool
- Fastest 3D around
- Elsa monitor control panel
- DVD software

MINUSES
- More expensive than the average GeForce Ultra
- Revelators induce earth-shattering headaches

THE SPECS

CORE SPEED	MEMORY	RAMDAC
250MHz	230MHz DDR SDRAM	350MHz



Although they make you look (even more) like a raging dork, the Revelator glasses add another dimension to 3D games.

QUAKE 3 DEMO001	QUAKE 3 QUAVER	3DMARK 16-BIT	3DMARK 32-BIT	SYSMARK 2000	MDK2
83	89.2	89.8	80.3	600	99.8

MAXIMUM PC VERDICT 9

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REVELATORS REVEALED

In order to explain how the Revelators work, we need to talk about how images are perceived in the third dimension.

You see depth because your eyes are several inches apart. This lets you see two images of everything from slightly different vantage points. These two images allow your brain to calculate the distance from you to whatever it is you're looking at. Why does this matter? The Revelators take advantage of this and another mental trick to create depth on a two-dimensional monitor. Rather than feed two discrete images into your brain, the glasses cover first one eye and then the other very, very quickly. The Revelators are designed to alternate the right and left images every 1/120th of a second, tricking your brain into thinking that it's seeing two discrete images, which therefore appear to have depth. It's worth noting that in order to get the best effect from these glasses, your monitor should support a refresh rate of 120Hz at the resolution you intend to play your games. The GeForce2 Ultra is the first chip capable of delivering high enough frame rates for shutter glasses to really work for gaming.

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Small Speakers, Big Sound

KLIPSCH, MIDILAND RAISE BAR IN 2.1 SPEAKER MARKET

Although it's a technology crime, several *Maximum PC* staffers have 4.1 speaker systems yet use only the front two speakers and the subwoofer. Hey, some of us simply don't have room for the rear satellites. Thankfully, speaker heavyweights Klipsch and S4 MidiLand have entered the 2.1 fray—cramped apartment dwellers may commence dancing in the streets immediately.

KLIPSCH PLUSES
- Seismic power
- Brilliant sound quality
- Headphone jack and auxiliary input
- Simple operation

MINUSES
- None

MIDILAND PLUSES
- Control module fits in 5.25-inch bay
- 3D Surround mode actually sounds good
- Better than average sound quality

MINUSES
- Only 60W output
- Tinny satellites
- Distortion at anything higher than half volume

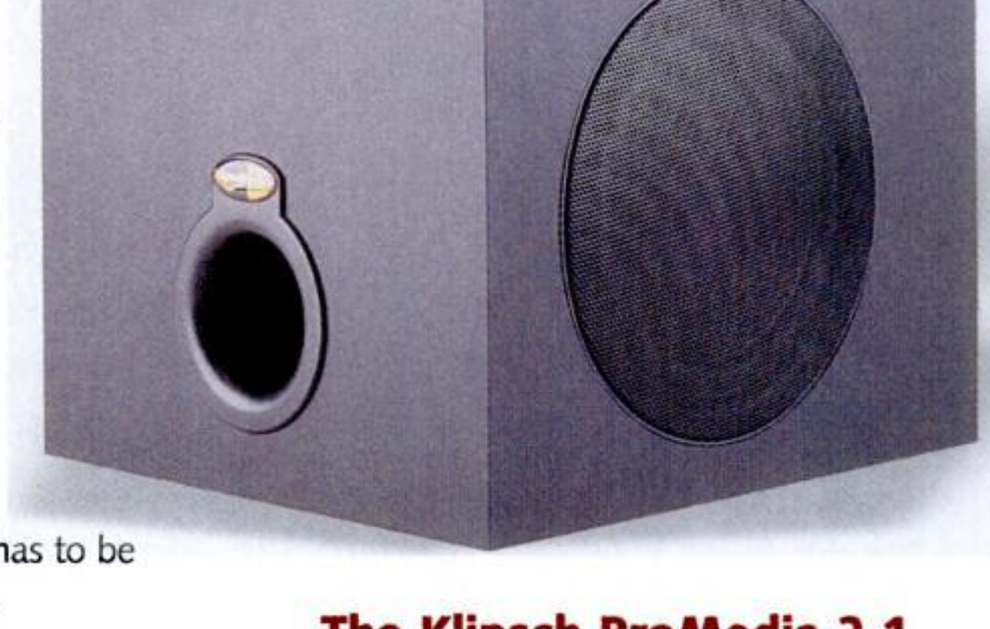
Klipsch ProMedia 2.1

Finally, Klipsch has entered the 2.1 speaker market. When we say "entered the market" we mean in a fashion similar to Sherman's army "entering" Atlanta during the Civil War. Sherman and his troops burned Atlanta to the ground, and, with the ProMedia 2.1 system, Klipsch is poised to decimate its rivals as well.

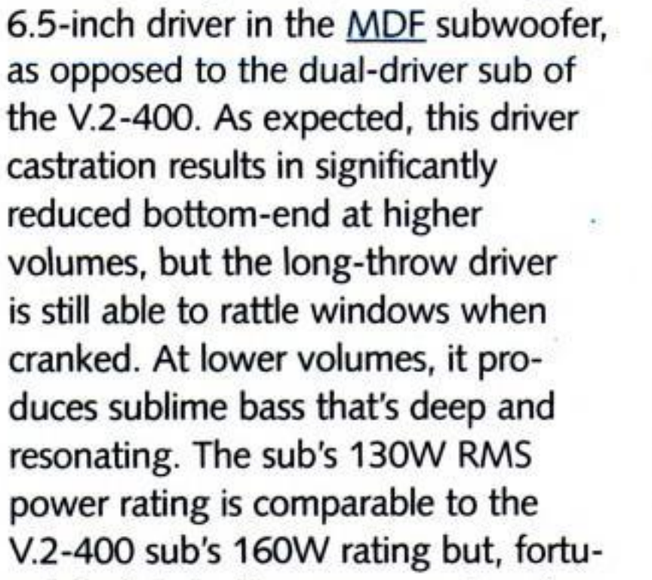
The ProMedia 2.1 differs from Klipsch's 4.1 offering—the V.2-400—in several ways. First, it uses a single 6.5-inch driver in the MDF subwoofer, as opposed to the dual-driver sub of the V.2-400. As expected, this driver castration results in significantly reduced bottom-end at higher volumes, but the long-throw driver is still able to rattle windows when cranked. At lower volumes, it produces sublime bass that's deep and resonating. The sub's 130W RMS power rating is comparable to the V.2-400 sub's 160W rating but, fortunately, it lacks the governor placed on its pricier sibling, so you can crank it up all the way without fear of protective volume reduction.

The satellites receive 35 watts apiece and are similar in appearance to their predecessors but feature a tweaked crossover for cleaner sound, better channel separation, reduced crosstalk, and improved midrange response. In testing, the changes are noticeable at lower volumes, but not in a night-and-day fashion. The control satellite also features a headphone jack (there is a God) and an auxiliary input for connecting an MP3 player.

Overall, the ProMedia 2.1 system rocked our world as much as the V.2-400 system did a year ago. Sound quality is superlative, the headphone jack is a godsend, and the outlandish output of this compact system has to be heard to be believed.



The Klipsch ProMedia 2.1 system reinforces the mantra "If it's too loud, you're too old."



The MidiLand 4060M system offers **only moderate wattage but decent sound quality with excellent controls.**

MidiLand 4060M

Just as the 2.1 ProMedia appears to be half of the V.2-400 system, the 4060M looks remarkably like a halved MidiLand 7100 set, which received a 9 verdict in October 00. It's not. MidiLand has tweaked the satellites to allow for five more watts of output, dropped the subwoofer's output from 50W to 30W so it won't overpower the sats, and changed the paint job from boring white to sexy silver. MidiLand has also added a feature we thought we'd hate—3D Real Surround Sound (3DRSS)—but it actually adds clarity and ambience to music and games, expanding the soundstage dramatically. One feature that is unchanged is the clever control box (with headphone jack) that can be mounted in a 5.25-inch drive bay.

The satellites receive 15 watts each and are made of a composite called "platallic" that is part metal, part plastic. Like other satellites made of plastic, the sats sound rather tinny, but still offer more warmth than other plastic enclosures we've heard. Highs are also reproduced with impressive clarity, although some midrange is sacrificed due to the presence of one full-range driver rather than separate midrange and tweeter drivers.

The subwoofer throws down a rather weak 30 watts, pumping out rich yet somewhat boomy bass at lower volumes. At higher volumes, the sub rattles the cabinet when the driver fully extends. Overall, the sub is perfectly matched to the sats at moderate listening levels, but if you crank up the volume, the sub craps out.

—Josh Norem

KLIPSCH PROMEDIA 2.1 — **10**

$200 | Klipsch
www.klipsch.com
800.554.7724

S4 MIDILAND 4060M — **8**

$150 | S4 MidiLand
www.midiland.com
888.592.1168

For definitions of Terminator words, check out the Terminator online at www.maximumpc.com.

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Firewire Hard Drives

MMMMM... 75GB OF HOT-SWAPPING STORAGE

File-swapping services such as *Napster* and *ProNster* are great for trading "entertainment," but heavy usage inevitably leads to a crisis—how to move gigabytes of data from one PC to another? Zip and CD-R are solid alternatives, but when you're dealing with the voluminous amount of "data" collected by staffers such as Gordon, larger capacity removable storage is a godsend. With FireWire hard drives, the problem is solved. Plug FireWire cards into two machines and whammo—75GB of hot-swapping removable storage at your fingertips.

Maxtor's sissified iMac aesthetics play host to the DiamondMax 80GB drive.

Maxtor DiamondMax 80GB FireWire

The DiamondMax 80GB is not a brand-new hard drive, but rather the same 5,400rpm drive we reviewed in August 00 (it received an 8 verdict) housed in a rugged external case with FireWire connectivity. The hot-swapping capability of FireWire is truly a bonus, but it comes at the cost of I/O transfer rates—this drive performs significantly slower than its IDE counterpart.

The repackaged DiamondMax drive outscored the LaCie drive in almost every synthetic benchmark, cranking out almost twice the throughput of LaCie's drive in most tests, but unfortunately reporting higher CPU utilization in *HD Tach* and *IOmeter*.

Although the Maxtor drive shined in synthetic tests, it was a dog in real-world testing. The Maxtor drive took almost twice as long as the LaCie drive to complete our file transfer test, taking 114 seconds compared to LaCie's 68 seconds.

The drive ships with everything you need to get started, with the exception of a FireWire card. Maxtor sells one for $50, but it only works with this specific Maxtor drive. We used a SIIG FireWire card for testing and it worked just fine with both drives in this roundup. For FireWire enthusiasts, Maxtor's drive offers everything except blinding transfer rates.

The LaCie 75GB drive looks like it's ready to take on a street gang—but our tests show that it can't.

LaCie 75GB FireWire

The LaCie drive is an IBM Deskstar 30GXP wrapped in an intimidating shell, but, despite its lean and mean looks, we found this drive's performance to be middling.

In all fairness, the drive performs as advertised. LaCie states that the drive pushes between 12 and 15MB/sec in read tests, and our testing confirmed these sluggish rates. The LaCie drive turned in 11MB/sec average read speeds in *HD Tach* and reported 13MB/sec in *IOmeter*. At these speeds, it takes quite a while to fill 75GB of space.

In our real-world benchmark test, however, the LaCie drive spanked the Maxtor drive. This isn't surprising, since the LaCie drive touts lower random access times combined with lower CPU utilization and a 7,200rpm spindle speed compared to the Maxtor's 5,400rpm. On paper, the LaCie looks bad, but in the real world it performs impressively. Unlike the Maxtor drive, however, the LaCie is much bulkier and is therefore not as portable. Also, for the price, this drive should include a FireWire card *and* a gift basket.

—Scott Tarr

MAXTOR PLUSES
- Fast synthetic benchmarks
- Small size

MINUSES
- Looks iMac-ish
- Slow real-world benchmarks

LACIE PLUSES
- Sinister looks
- Sweet real-world benchmarks

MINUSES
- Big footprint
- Poor synthetic benchmarks
- Pricey

BENCHMARKS	LACIE	MAXTOR
HD TACH		
Random access time	**13.5ms**	22.7ms
Read burst	13.1MB/sec	**20.6MB/sec**
Average reads	11.06MB/sec	**14.96MB/sec**
CPU utilization	**3.1%**	4.2%
IOMETER		
Max read speed[1]	12.86MB/sec	**20.25MB/sec**
CPU utilization	**2.96%**	4.02%
Random access test[2]	**168.24tps**	160.51tps
Real-world test	68 secs.	**114 secs.**

Notes: We tested using Windows 2000 w/ SP1 using a SIIG FireWire card. [1]Performs 64K sequential reads across the whole drive delivering a maximum throughput in MB/sec. [2]Performs 2K random reads (67%) and writes (33%) across the whole drive, representing a typical workstation load.

MAXTOR — 7

$400 | Maxtor
www.maxtor.com
800.262.9867

LACIE — 7

$750 | LaCie
www.lacie.com
503.844.4502

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Internet Phone Kits

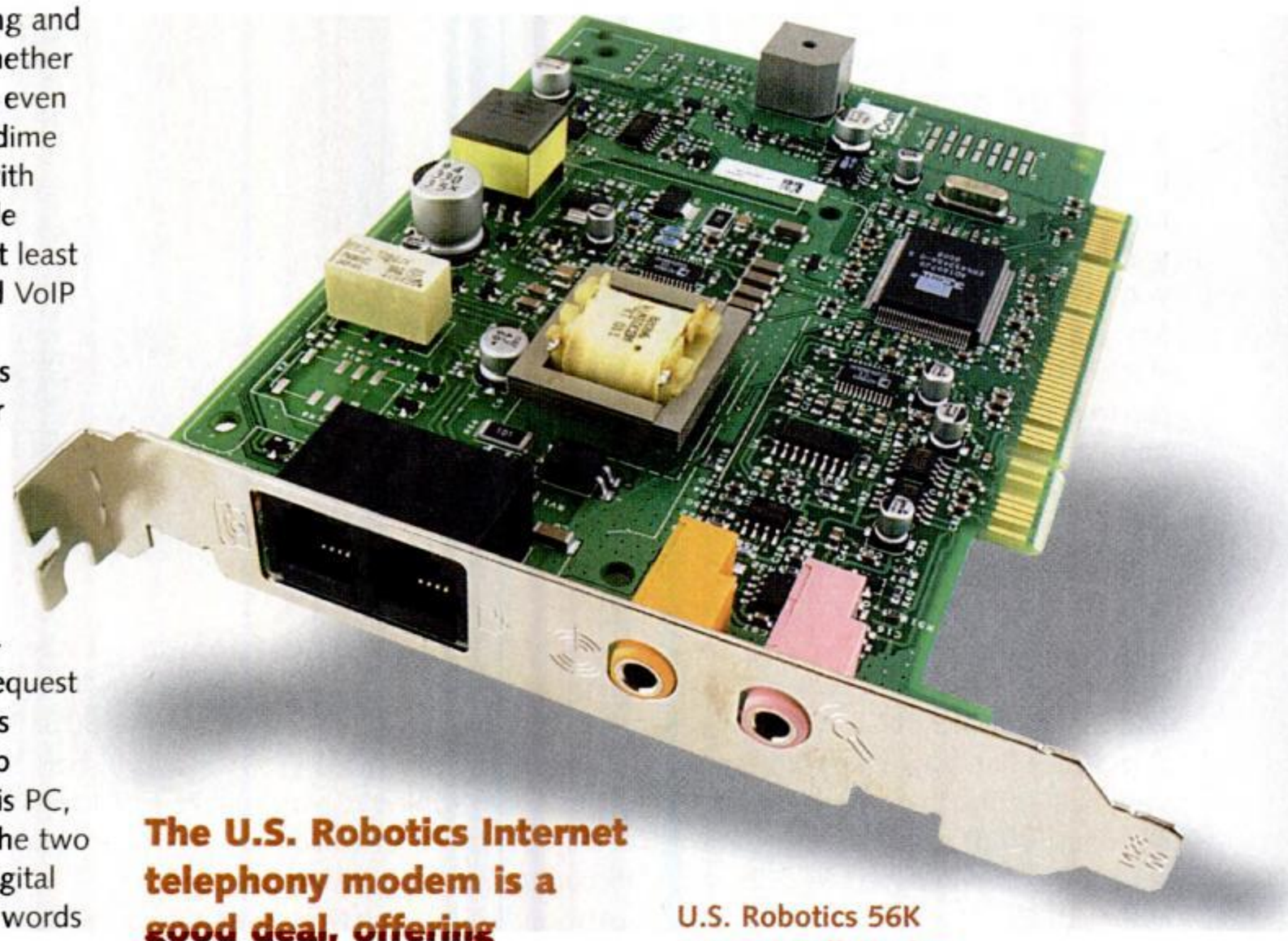
VOICE OVER I.P. SOUNDS LIKE A GOOD DEAL—BUT ISN'T

The Internet is about one thing and one thing only: free stuff. Whether it's news, message boards, or even porn, we don't like paying a dime for anything that has to do with the Internet. Now the free ride includes making free—well, at least cheap—phone calls. It's called VoIP (voice over I.P.).

The scheme typically works like this: You sit down at your PC and type in the phone number you want to call. Your call request snakes through the Internet until it hits the right VoIP server, which then taps into the telephone network to send the request to your friend's telephone. His phone rings and he picks it up (unless he also has VoIP on his PC, in which case his PC rings). The two of you begin conversing as digital data packets containing your words fly across the Internet.

On one hand, VoIP technology allows you to screw your phone company out of long-distance bills because all phone network activity in the VoIP equation transpires at the local-call level. That's the upside. But let's consider the downside. For starters, maintenance of Internet transmission lines is in the hands of neither your VoIP hardware vendor nor your ISP. This means that when a hub goes down and your calls can't connect, the provider is entitled to shrug its shoulders and smile.

What's more, the quality of Internet phone calls can royally suck. With a cable modem connection on a fast PC and low Internet traffic, there's still a noticeable delay of several seconds in the transmission of sound. A typical scenario: You think your buddy has stopped talking (because of the time delay), so you respond, and are then interrupted by his delayed response. You stop once you hear him, and he stops once he hears you. This kind of thing happens repeatedly on Internet phone calls, making patience not only a virtue, but a necessity. And that's on a *good* day.



The U.S. Robotics Internet telephony modem is a good deal, offering decent sound quality and free PC-to-phone calls in the U.S. and Canada.

On an average day, with a slower connection, the transmission delay can be much longer, and a higher volume of Internet traffic can lead to increased background noise and clipping—that annoying loss of signal that creates dropouts in communication. When this happens in the transmission of file data, the packet is automatically resent. Not so with VoIP. Trust us: When you start hearing every other syllable in an Internet conversation, you might as well give up.

And don't even think of running an actively cycling app while in the middle of a VoIP-based phone call. You can do some work in *Word* in the background, but a phone call isn't meant to be dormant. Surfing the web while making an Internet call will result in an unintelligible conversation.

Some say there's no such thing as a free lunch, and this may be true regarding phone calls over the Internet. Bear in mind these caveats before you dive into Internet telephony.

U.S. Robotics

PLUSES

- Free PC-to-phone calls in the U.S. and Canada
- Modem and Internet telephony
- Reasonably good sound quality
- Easy installation
- Cheap phone rates

MINUSES

- Drivers are automatically installed in the startup tray

U.S. Robotics 56K Internet Call Modem

This unit differs from the rest of this group in that it offers two services: VoIP technology and a 56K modem. No special installation is required; the hardware installs easily into any PCI slot. Loading the software whisks you away to the web site of Net2Phone, which is the product's contract provider for Internet telephony services. A second software disk called "Connections CD" is also provided with the program, but we suggest using it as a coaster. It's loaded with "special offers," crippled shareware, and decent but uninspiring shareware such as *Netscape* 5.

The unit's VoIP capabilities are completely integrated into the modem. Making an Internet phone call typically bears some resemblance to standard phoning procedures from the 1930s (ring operator, place call, wait for operator to connect), and the USR modem is no less tedious in this respect.

To make a call, you first have to execute a pair of drivers and the *Net2Phone* software. (Luckily, the drivers don't hog a lot of memory and resources, but we do object to the wanton clogging of our startup tray with extra items.) Next, you

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dial the phone, wait for the operator to connect, and hold while the call is placed. Most calls took 30 seconds to a minute to go through, and roughly 20 percent of the time, our calls were simply lost (this is par for the course with VoIP devices). Another ding is that during testing we found it impossible to dial extensions successfully once the call had been routed and answered. Holding down the 0 button for a while would connect us to the operator, but that was about as good as it got.

On a positive note, sound quality with this device was reasonably good—clear and intelligible, with only slight clipping when the Internet was behaving itself.

Unlike the other services in this roundup, Net2Phone allows you to call anywhere in the U.S. and Canada for free, even if the recipient isn't using a similar VoIP device. Overseas calls are also free if both parties to the conversation are using Net2Phone accounts.

Considering its decent sound quality, ease of installation, and practical pricing schemes, we found the USR call modem to be the star of this head-to-head-to-head.

Creative Voip Blaster

At $20, this sucker is certainly a bargain. As for installation... what installation? You connect the Blaster (which resembles a small, black electric razor) to your PC's USB port, and Windows asks for the Blaster's disk. Then you establish an account with InnoMedia, Creative Labs' ISP of choice—and that's it.

Creative's VoIP product is easy to use, but suffers from lackluster voice quality and rinky-dink earplugs.

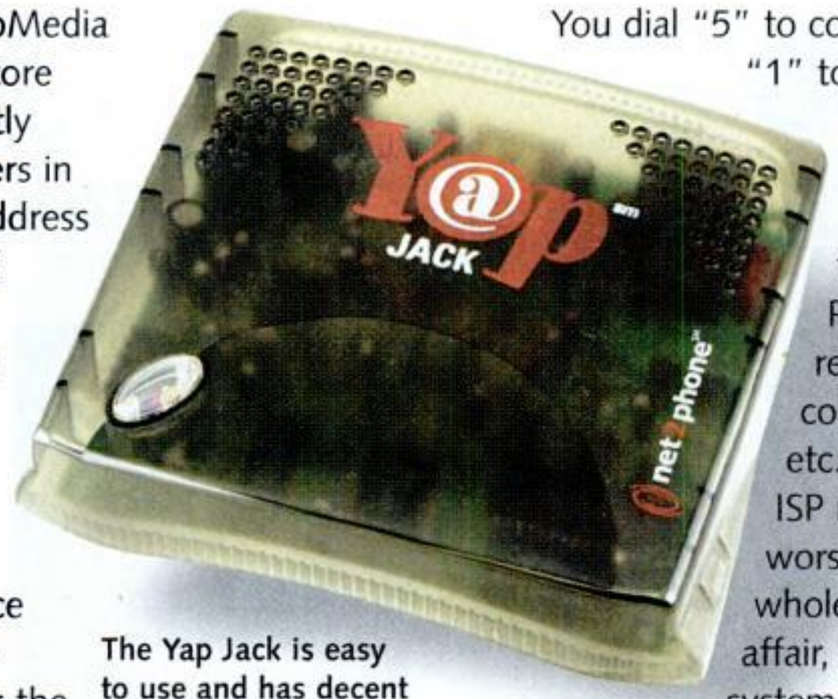
Phone calls are surprisingly easy to make using the Blaster. The software stays resident in your taskbar (damnit!) and displays an onscreen image of a cell phone that you can dial with your mouse. This same image-as-menu also lets you review your call history, check your online InnoMedia account, store and instantly dial numbers in a simple address book, send voicemail, and switch between PC-to-PC and PC-to-phone mode. Once you've finished using the Blaster, simply remove it from the port, and the device driver is automatically uninstalled.

The Blaster's sound quality, however, shares the failing of all stand-alone speakerphones—ambient room noise punishes sound quality. Equally problematic is the tiny hands-free earphone that comes with the unit—it's lacking in both audio isolation and frequency response. Volume was acceptable, but we noticed a distinct lack of treble, making voices sound dull and lifeless. We recommend buying a separate phone handset if you decide to purchase this device. It raises the price of your investment, but moves the device's sound quality into the acceptable range. Overall, we found the Creative Voip Blaster extremely easy to use, but of insufficient quality to merit recommendation.

Yap Jack

Net2Phone's Yap Jack looks like a larger version of the Creative Voip Blaster and is about the size of a piece of toast. What sets it apart from other VoIP devices is the fact that it doesn't need to be connected to your computer at all. Once you've established an ISP account, long-distance phone calls can be made by plugging the Yap Jack into both your phone and the phone jack (as an intermediary between the two).

Without the visual aid of online dialog boxes, Yap Jack's configuration menus take some time to navigate.



The Yap Jack is easy to use and has decent sound quality, but its tedious configuration and operation are a major drag.

You dial "5" to configure, then "1" to enter your Net2Phone account number, "2" to enter your PIN, "7" to review your configuration, etc. Entering your ISP name is the worst part of the whole troublesome affair, since the system is case-sensitive and depends upon annoyingly repetitive alphanumeric codes. The "H" in Henry requires pressing the "4" key six times, for instance, while the "y" requires pressing the "9" key four times. Configuration fortunately needs to be done only once.

Using the Yap Jack also proved to be a chore. First you dial the number, then you hang up the phone. Wait, it gets better! Next, the phone rings back—this means your phone call has gone through and is trying to connect, not that your party has answered. On average, we waited a minute or longer before getting that return phone call, though occasionally the wait stretched to about five minutes. The Yap Jack comes with $10 worth of free phone calls. As with the U.S. Robotics unit, phone calls between Net2Phone devices are free.

Sound quality on the Yap Jack was as good as that of the U.S. Robotics call modem as well. But given the difficulties in configuring this device and the delays in placing a phone call, we found it an inferior communications tool compared to the USR modem.

—Barry Brenesal

Creative

PLUSES
- Easy installation
- Cheap phone rates

MINUSES
- Flimsy, inadequate earphone
- Strong ambient noise
- Attenuated high-frequency response

Yap Jack

PLUSES
- Light and small, perfect for travel
- Reasonably good sound quality
- No computer necessary
- Cheap phone rates

MINUSES
- Installation/configuration process by phone is a major hassle
- Long wait for processing phone calls
- Provides no handset; at $160, it should

U.S. ROBOTICS56K — 8
$100 | U.S. Robotics
www.usr.com | 866.2.USR.NOW

CREATIVE VOIP BLASTER — 6
$20 | Creative Labs
www.creativelabs.com
405.742.6622

THE YAP JACK — 6
$160 | Net2Phone
www.yapgear.com
201.968.3202

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Alice

NEUROTIC ADVENTURE IS BEAUTIFUL BUT BORING

Alice, from former id Software programmer American McGee (of *Doom* and *Quake* fame), is a game that's certainly, well... *interesting*. We mean that as a compliment, of course, but "interesting" doesn't always mean "fun," and *Alice* is more of a curiosity than a must-have title.

***Alice* is best described by the Keanu Reeves catchphrase "Whooaaa." It's quite trippy, but rather slow-paced as well.**

PLUSES
- Captivating artwork
- Interesting interpretation of *Alice in Wonderland*

MINUSES
- Puzzle-based gameplay gets old fast
- Plodding storyline
- Tedious cutscenes and combat

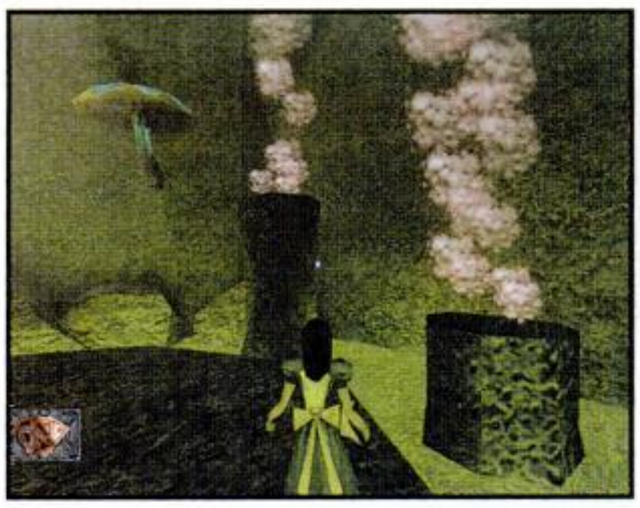
THE SPECS

3D CARD SUPPORT	3D AUDIO SUPPORT	MULTIPLAYER	TOTAL PLAYERS
OpenGL	A3D	None	1

Gameplay

Alice is American McGee's interpretation of the *Alice's Adventures in Wonderland* fable. Because there are no copyright restrictions on Lewis Carroll's public-domain classic, McGee and his team were able to go hog wild with game environments—and did they ever. A decidedly neurotic Alice must fight her way through a sinister, twisted version of Wonderland in order to regain her sanity; consequently, the game offers some of the most whacked-out environments we've ever seen—misty underground lairs, floors that float in the middle of spinning vortexes, and flame-infested levels that simulate the depths of Hades. We don't do hallucinogens, but playing *Alice* made us wish we were so inclined.

Although the level design is generally ultra-imaginative, *Alice* quickly abandons awesome indoor levels for less inspiring outdoor levels. We'd rather play around in a spooky Victorian mansion stuck in a swirling vortex or in a maddening house of mirrors than in a hostile garden any day. Gameplay itself is lackluster—completely linear and puzzle-based, with puzzles that aren't particularly original or challenging.



These steam fountains let Alice "ride the wind" and are one of a litany of boring jumping puzzles found throughout the game.

Between puzzles, you're subjected to tedious cutscenes and methodical combat against a variety of flora and fauna such as poisonous plants, army ants, and militaristic ladybugs. A small cache of tools is provided for dispensing with the foes, but too few of them inflict major damage or are accompanied by frightening sound effects. The exception is the Ragebox power-up, which allows Alice to unleash her pent-up hostility for a short time period. This sends Alice into what we like to call "PMS mode," replete with horns, incredible strength, and a blood-red halo around her body. Still, as is the case with most of the power-ups littered throughout the game, whenever you find the Ragebox, enemies are few and far between, and when you finally do encounter something to smoke, the power-up peters out.

Technology

Alice is a *Quake III*-based game, so it looks absolutely stunning. The textures used throughout the game are vividly colored and highly detailed; rarely do you get the sense that you're seeing the same textures repeated over and over. The developers even imported the engine additions made by Ritual Entertainment for *F.A.K.K. 2*, the most significant of which are realistic procedural textures for fire, smoke, and blood effects, and skeletal animation for lifelike character movement. The good news is that everything looks amazing. The bad news is that Alice will make even burly systems break a sweat. We had to play at 640x480 on our P-III 733, GeForce 256 SDR test machine.

Forget about multiplayer—*Alice* is a single-player game only. This isn't a detriment though, because combat in *Alice* is more of an annoyance than a visceral experience.

Our staff was in agreement about *Alice*'s merit. We all think it's a gorgeous game, but, just like choosing a romantic partner, good looks don't mean jack without deeper qualities to back them up. *Alice* fails in this regard but deserves accolades for its unique level design, interesting artwork, and psycho-scary subtext.

—Josh Norem

ALICE	
TECHNOLOGY	9
GAMEPLAY	6

$40 | Electronic Arts | www.alice.ea.com
877.324.2637

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Giants: Citizen Kabuto

BIG FUN

Giants: Citizen Kabuto sprang from the minds of former Shiny Entertainment personnel, a fact that's obvious from the moment you set eyes on this quirky third-person game. It has the same style, attention to detail, focus on story, and bold innovation that *Earthworm Jim*, *MDK*, and the more recent *Sacrifice* displayed. *Giants* is the reigning king of arcade-style action games, edging out Bioware's *MDK2* by a nose.

PLUSES
- Beautiful graphics
- Three very different styles of gameplay
- Witty writing and cutscenes
- Flying, jet skiing, and stomping in one game

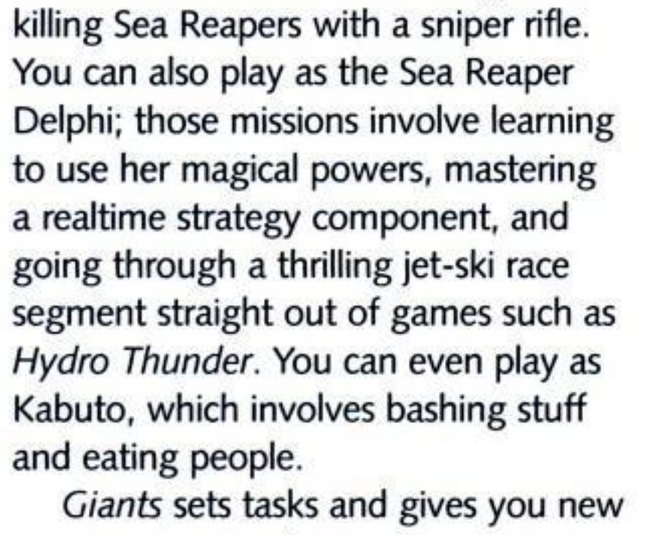
MINUSES
- No in-mission save
- Laggy multiplayer
- Poor multiplayer balance

Gameplay

The action takes place on a strange island that's inhabited by a moronic race of peaceful villagers. Sadly, these kind folks are being oppressed by an evil bunch of Sea Reapers. The Reapers are trying to get rid of the villagers and regain control of their 30-foot tall protector named Kabuto, who is currently on a rampage.

You are a member of a technologically inclined group called the Meccs, who have the use of various guns and a cool jetpack. Gameplay runs the gamut from swooping around like Batman in order to rescue villagers to killing Sea Reapers with a sniper rifle. You can also play as the Sea Reaper Delphi; those missions involve learning to use her magical powers, mastering a realtime strategy component, and going through a thrilling jet-ski race segment straight out of games such as *Hydro Thunder*. You can even play as Kabuto, which involves bashing stuff and eating people.

Giants sets tasks and gives you new powers at a steady pace, so you never get bored or confused. The developers didn't include an in-mission save feature, which is fine for most of the game, but longer missions beg for such convenience.



Apparently, Sea Reapers get around on their **own personal watercraft. In *Giants*, you get to race these souped-up jet skis.**

Giants combines varied game types with absolutely stunning graphics.

Interestingly, Interplay put a bra on Delphi and colored the Reapers' blood green in a failed attempt to avoid a "Mature" rating, but rest assured, the green blood can be removed with a simple patch, and the bra can be cast asunder by deleting the "arpfix.gzp" file in the Bin folder.

Technology

Giants is certainly beautiful. The game engine cranks out odd alien plant life, rolling hills, mountains, and completely destructible buildings. Characters are well animated and feature high polygon counts (2,000 for the Meccs and Reapers and a whopping 7,000 for Kabuto alone). Additionally, the developers took advantage of hardware transform and lighting, dynamic LOD (level of detail, which helps slower machines handle the engine), and multi-pass technology to handle water and landscape texturing. *Giants* consists almost exclusively of outdoor levels but doesn't rely on tricks such as fogging or terrain pop-up to keep frame rates high. Like *Sacrifice*, *Giants* is a hardware whore that will definitely tax your system.

Unfortunately, the multiplayer isn't as righteous as the single player campaign. On a broadband Internet connection or a LAN there is significant lag. Even worse, the game's balance is out of whack. The Sea Reapers' magical powers give them a significant advantage over the Meccs, and Kabuto is practically invulnerable due to his size, which makes finding a well-balanced game impossible.

THE SPECS

3D CARD SUPPORT
Direct3D

3D AUDIO SUPPORT
EAX

NETWORK SUPPORT
TCP/IP, LAN

TOTAL PLAYERS
1 to 4

Giants is a superlative action game. You get straight-up shooting, high-flying action, jet-ski racing, realtime strategy, and—the pièce de résistance—running around as a 30-foot giant and stuffing people into your gaping maw. It's got some problems, but overall, *Giants* gets our seal of approval.

—Andrew S. Bub

GIANTS

TECHNOLOGY	8
GAMEPLAY	8

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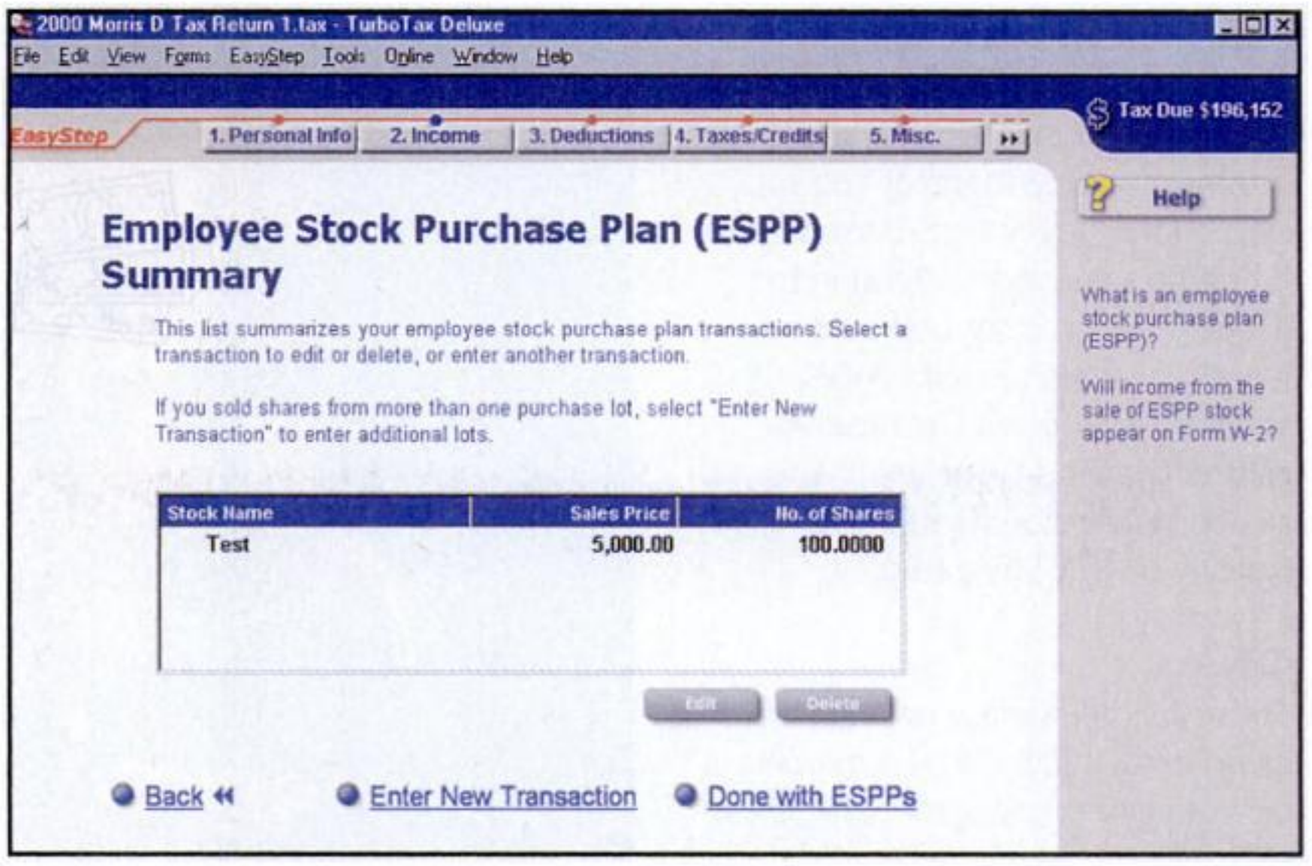

PLUSES
Allows importing from most other tax packages
Streamlined interview process
Tax advice is truly helpful

MINUSES
We don't like rebate scheme

This is getting boring. Every year we rave about Intuit's *TurboTax*, and this year the tax-busting software is better than ever. Upgrades for the 2000 version include a raft of features designed to make the tax preparation process less painful. The software offers in-depth assistance for each step of the tax preparation process and automates much of the ordeal if you meet certain criteria.

The automation process starts with *TurboTax*'s ability to import 1999 tax information from almost every tax program on the market, including Kiplinger's *TaxCut* and Microsoft's now-defunct *TaxSaver*. *TurboTax* also offers a new feature that allows you to download various W2, 1099, and investment transaction forms from participating providers (payroll companies, stock brokerages, etc.). It's a great concept, but if you're a frequent stock trader or worked for several companies last year (and if all happen to use the same payroll service provider), you'll have to log on, sign up, get your password, download all the information and check the downloaded data for accuracy. By that time, the rest of us will have entered all our information manually, checked it twice, and retired to the couch for Hot Pockets and brewski. Perhaps this feature will flourish when all employers are able to share information.

Once you have your information entered into *TurboTax*, you're bound to have questions about how to deduct kitty litter purchases as a work expense. *TurboTax* provides more tax help than you'd ever want to read—and all of it is easy to digest and extremely useful. The new version also includes video tax help from financial experts Marshall Loeb and Mary Sprouse (whoever they are).

TurboTax's step-by-step interview process makes dealing with complicated transactions such as the Employee Stock Purchase Plan (ESPP) a breeze.

Live tax advice is available through *TurboTax*'s web interface, but you'll be charged a fee for it. And if you don't have an Internet connection, you won't get the full benefit of the software. Intuit ships the product after the IRS finalizes its forms, and since the forms come out several months before taxes are due, Intuit is forced to add up-to-date information to the product via the Internet.

TurboTax's "interview" process (which you should use unless you are a tax expert) gracefully guides you through all phases of your tax return. Even the more complicated tax aspects are well-described and deftly handled by *TurboTax*. If you're a gazillionaire or have a very complicated tax situation, *TurboTax* won't be an acceptable replacement for a professional C.P.A. (Frankly, for $30, you shouldn't expect a product that can handle the taxes of Chevron Corp.)

Federal tax forms are included with the software, and the *Deluxe* package reviewed here includes one free state form download. The package also allows one free electronic filing, but it's only good for the filing of one 1040 form. There's a catch, too: You have to pay for the filing, and then send in a rebate form. Any other filings cost $12 a pop. We think this rebate approach is a pain in the wazoo, as we hate waiting for rebates to be sent back (if they ever are). For next year, we'd appreciate a flat offer that doesn't involve rebates.

When the taxman cometh, *TurboTax* minimizes common tax preparation errors, provides food for thought on tax-saving alternatives, and lives up to its "Turbo" tag by streamlining the entire process.

—Daniel D. Morris, C.P.A.

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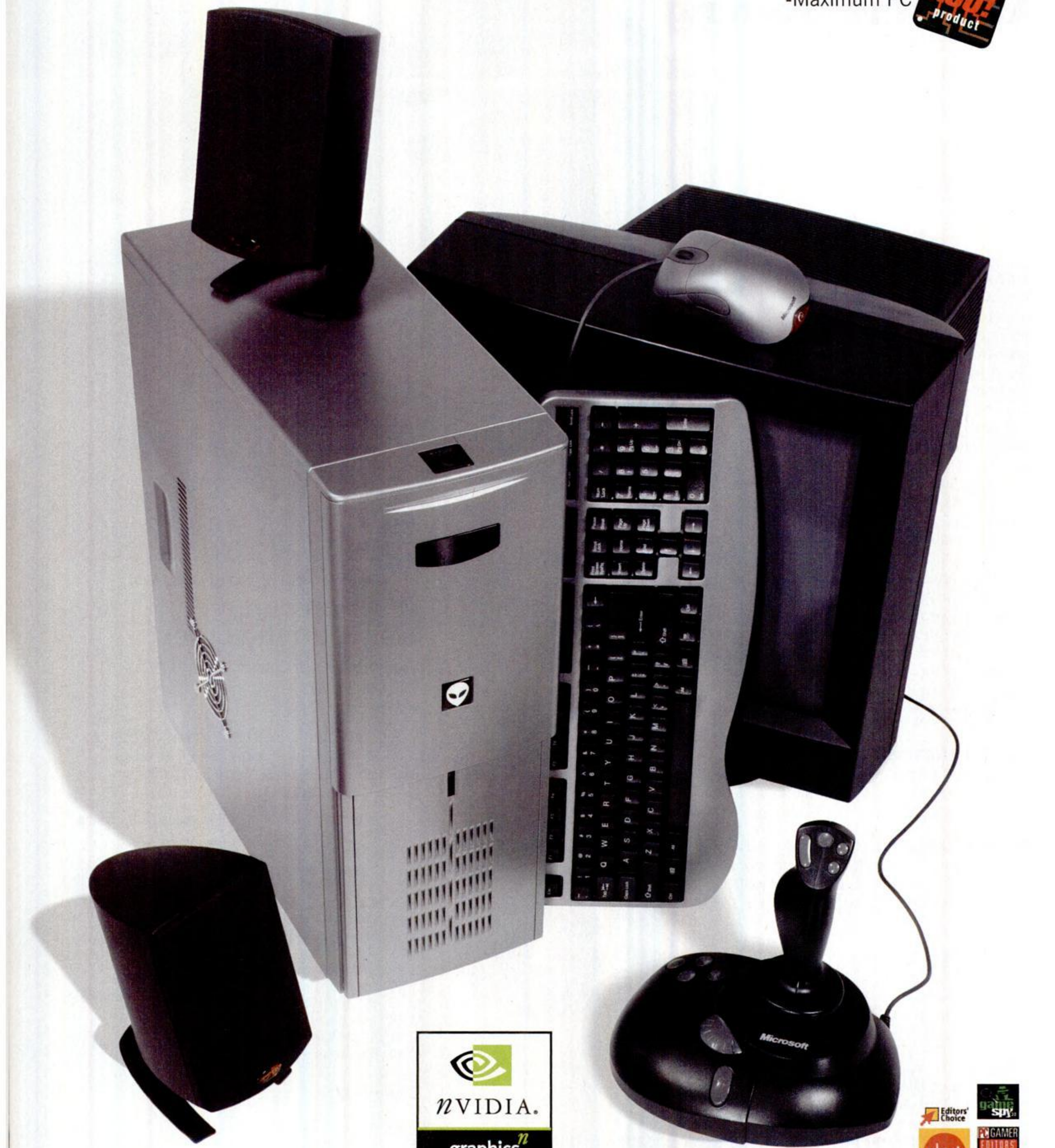

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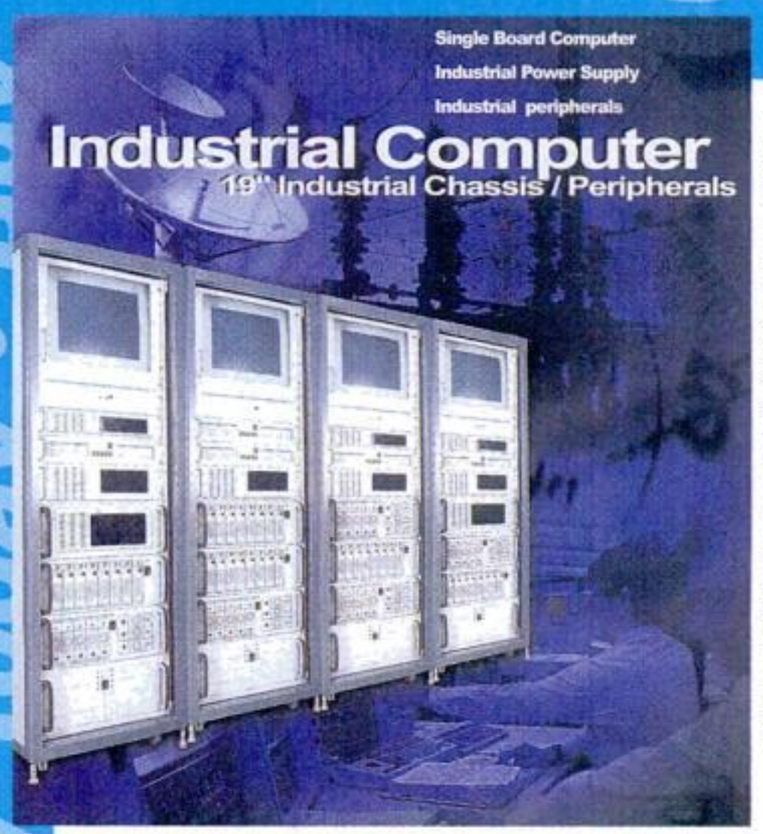

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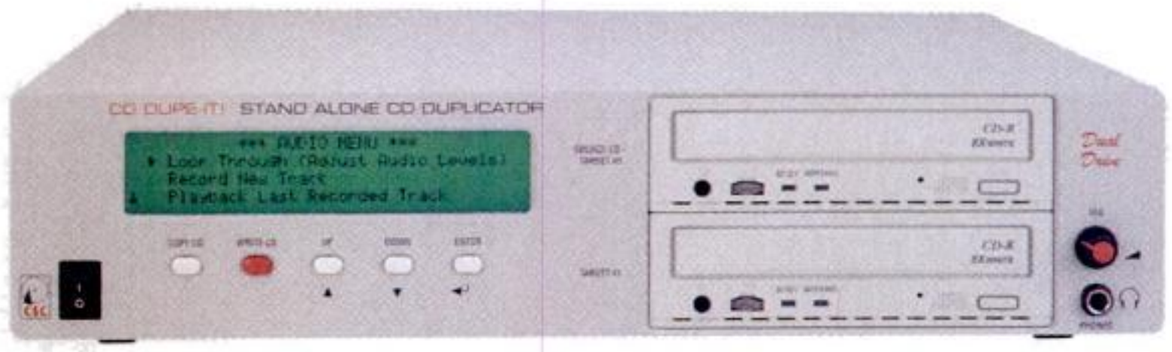

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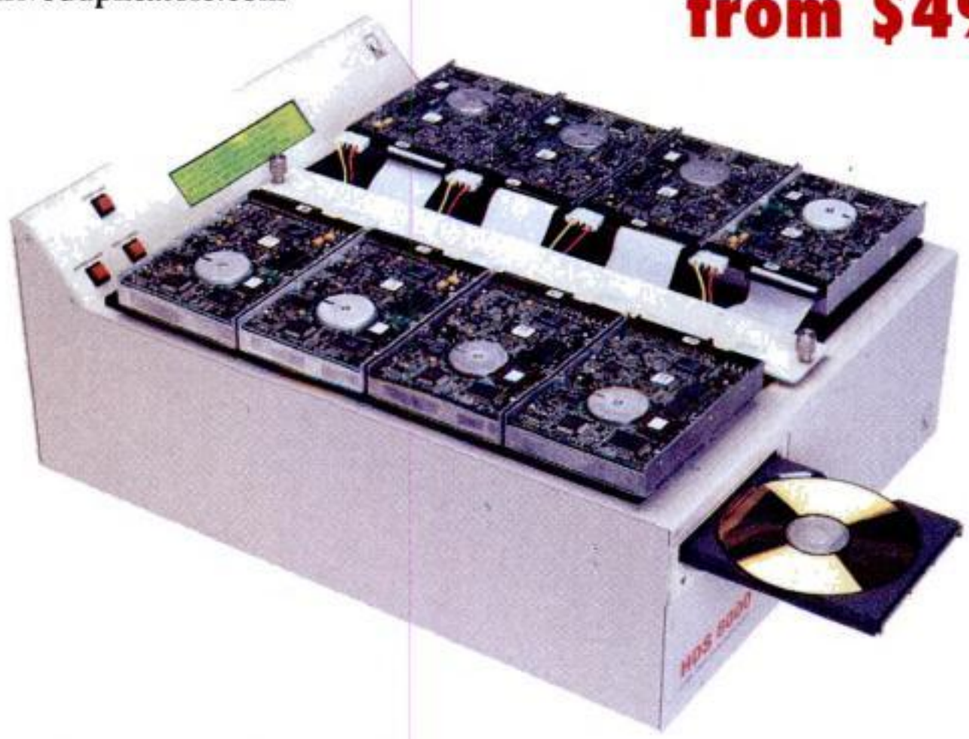

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NEXT MONTH

In the April issue of MAXIMUM PC

nVIDIA'S NEW 3D SCREAMER!

Its codename is NV20, and it aims to offer the fastest, most visually stunning 3D experience gamers have ever seen. Next month we'll give you the full report on nVidia's upcoming supercard, the first DirectX 8-compliant 3D accelerator to land in our Lab. What visual effects does it enable? How fast does it run the most demanding games? How does it actually conjure its pixel-pumping magic? We reveal all in the April issue.

Fixes and Trixes for Your Digital Pixes

The quality of your digital photos might royally suck—but they certainly don't have to. We'll show you a bunch of tricks to improve the quality of your images. All you'll need is the software that came with your camera or the applications available on next month's Maximum CD.

Hardware that Changed History

3dfx's first 3D chipset might be woefully underpowered by today's standards, but back in 1997 it almost single-handedly defined the PC power-user experience. *Maximum PC* takes a trip down SDRAM Lane to present all the different hardware that made power users what they are today.

Tools of the Trade

How often do you find yourself working inside your machine's engine bay? If you're a PC-tinkering fool, you need to outfit yourself with the absolute best tools of the trade. Next month we present everything you'll need to create the ultimate PC workshop.

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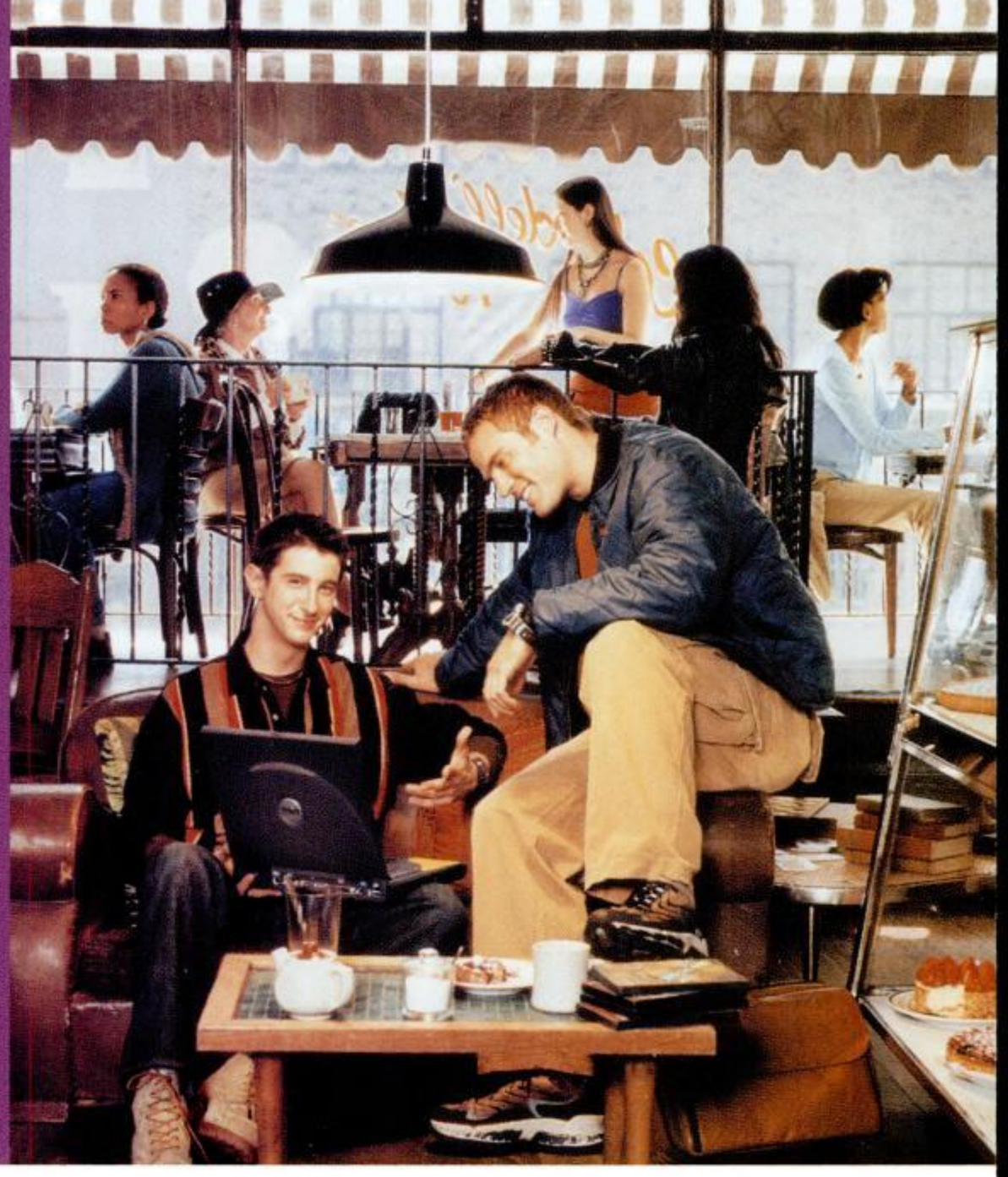

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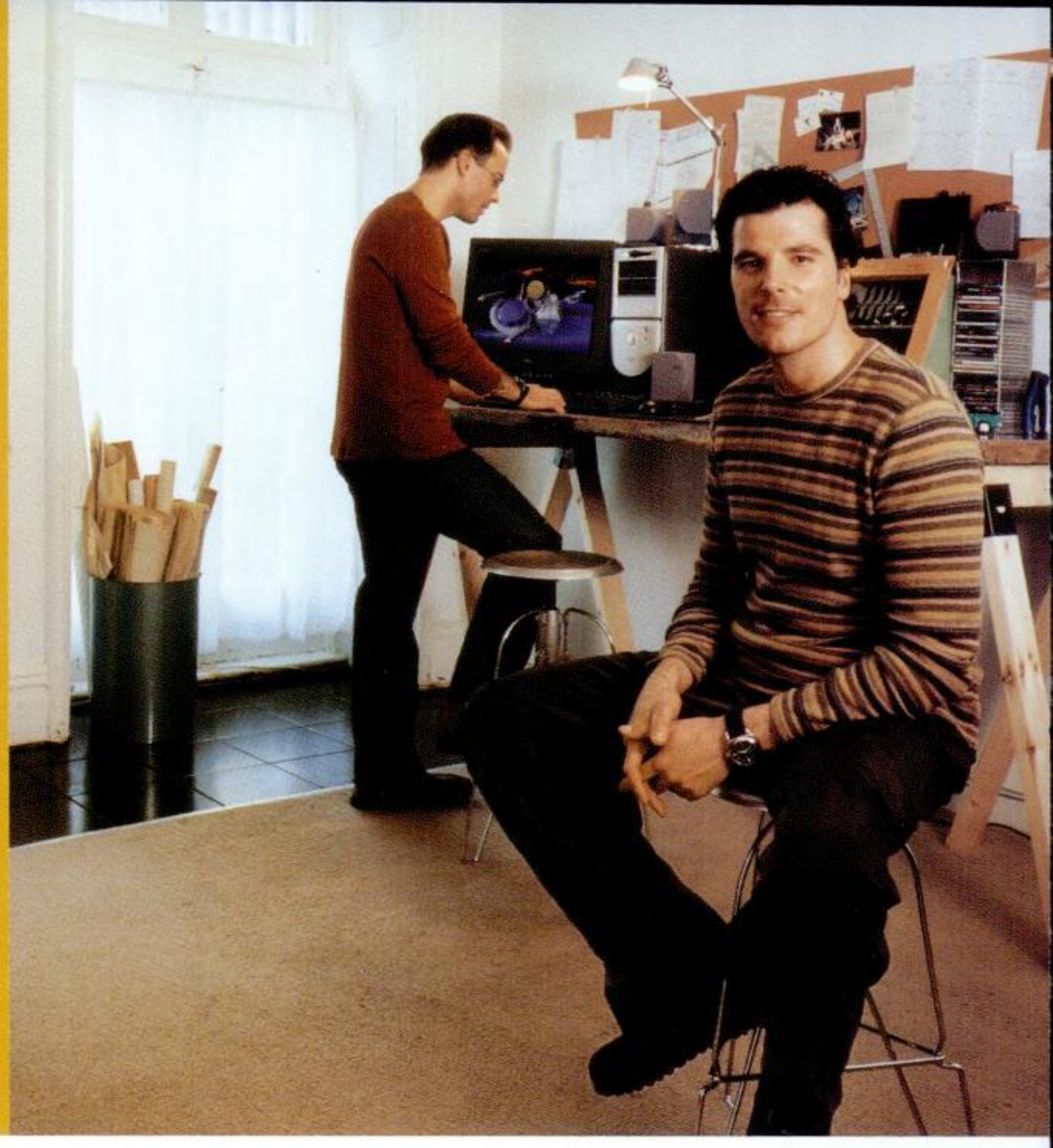

Introducing the All-New Dell™ Dimension™ 8100 with an Intel® Pentium® 4 processor. Over-the-top performance for those who can handle it.

DELL™ DIMENSION™ 8100 Series

NEW—Cutting-Edge Technology

- Intel® Pentium® 4 Processor at 1.3GHz
- 128MB RDRAM
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- 19" (18.0" vis) M991 Monitor
- 32MB NVIDIA™ TNT2 M64 4X AGP Graphics
- 48X Max CD-ROM Drive ■ SB Live! Value Digital
- harman/kardon® Speakers
- 56K Capable[6] PCI Telephony Modem for Windows®
- Integrated 3Com® 10/100 Ethernet Controller
- MS® Works Suite 2001 ■ MS® Windows® Me
- 3-Yr Limited Warranty[2] ■ 1-Yr At-Home Service[4]
- 1 Year of DellNet™ by MSN® Internet Access[10] Included

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intel inside pentium 4

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Includes Windows Millennium Edition — the home version of the world's favorite software.

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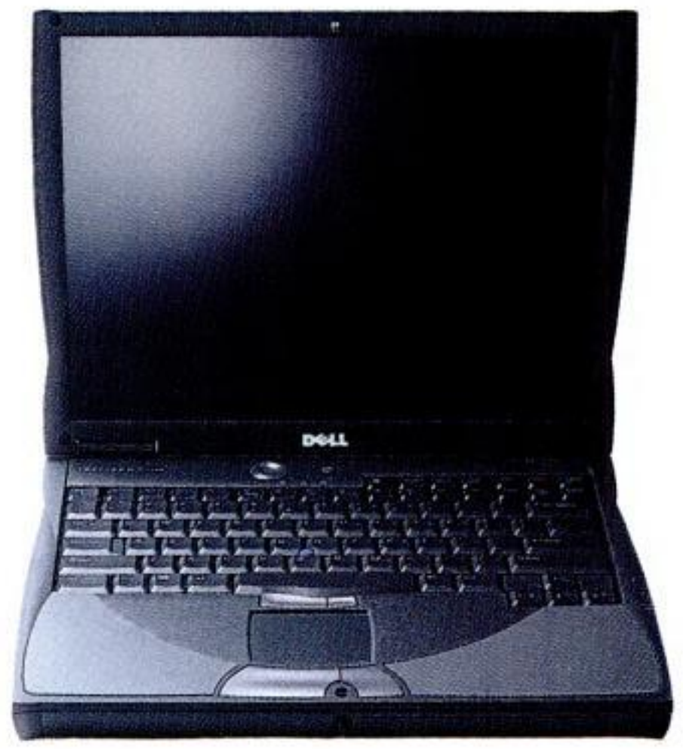

Dell™ Inspiron™ 4000 Notebook

DELL™ NOTEBOOKS:

DELL™ INSPIRON™ 4000

Thin and Light

- Intel® Pentium® III Processor at 650MHz Featuring Intel® SpeedStep™ Technology
- 14.1" XGA TFT Display
- 64MB 100MHz SDRAM
- 10GB[5] Ultra ATA Hard Drive
- Modular Removable 8X Max DVD-ROM Drive
- 2X AGP 8MB ATI Rage Mobility™ 128 3D® Video
- Internal 56K Capable[6] FaxModem
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- MS® Works Suite 2001 ■ MS® Windows® Me
- 1-Yr Limited Warranty[2] ■ 1-Yr Mail-in Service
- 1 Year of DellNet™ by MSN® Internet Access[10] Included

$1699 or as low as **$51** per mo. 45 mos.[12]

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DELL™ INSPIRON™ 8000

Multimedia Mobile Desktop

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- 14" Super XGA+ TFT Display
- 128MB 100MHz SDRAM
- 10GB[5] Ultra ATA Hard Drive
- Fixed 8X Max DVD-ROM Drive
- 4X AGP 32MB ATI Rage Mobility™-M4 3D® Video
- Internal 56K Capable[6] FaxModem
- 59WHr Li-Ion Battery ■ harman/kardon® Audio
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- 3-Yr Next-Business-Day On-site Service[4]
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DELL™ INSPIRON™ 8000

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- Intel® Pentium® III Processor at 800MHz
- 15" Super XGA+ TFT Display
- 128MB 100MHz SDRAM
- 10GB[5] Ultra ATA Hard Drive
- Fixed 8X Max DVD-ROM Drive
- Modular 8X Max CD-RW
- 4X AGP 32MB ATI Rage Mobility™-M4 3D® Video
- harman/kardon® Audio
- Internal 56K Capable[6] FaxModem
- MS® Works Suite 2001 ■ MS® Windows® Me
- 3-Yr Limited Warranty[2]
- 3-Yr Next-Business-Day On-site Service[4]
- 1 Year of DellNet™ by MSN® Internet Access[10] Included

$2779 or as low as **$83** per mo. 45 mos.[12]

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Affordable Desktop Solution

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- 64MB SDRAM ■ 20GB[5] Ultra ATA/100 Hard Drive
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- Intel® 3D® AGP Graphics
- 48X Max CD-ROM Drive
- SoundBlaster 64V PCI LC Sound Card
- PC Speakers
- 56K Capable[6] PCI DataFax Modem for Windows®
- MS® Works Suite 2001 ■ MS® Windows® Me
- 1-Yr Limited Warranty[2] ■ 1-Yr At-Home Service[4]
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Advanced Performance, Smart Value

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- 128MB SDRAM at 133MHz
- 20GB[5] Ultra ATA/100 Hard Drive (7200 RPM)
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- 16MB ATI Rage™ 128 Pro
- 48X Max CD-ROM ■ SB Live! Value Digital
- harman/kardon® Speakers
- U.S. Robotics® 56K Capable[6] PCI Telephony Modem
- MS® Works Suite 2001 ■ MS® Windows® Me
- 3-Yr Limited Warranty[2] ■ 1-Yr At-Home Service[4]
- 1 Year of DellNet™ by MSN® Internet Access[10] Included

$1299 or as low as **$39** per mo. 45 mos.[12]

No payments for 90 days. E-VALUE Code: 89900-500212

DELL™ DIMENSION™ 8100 Series

Cutting-Edge Technology

- Intel® Pentium® 4 Processor at 1.3GHz
- 128MB RDRAM
- 40GB[5] Ultra ATA/100 Hard Drive (7200 RPM)
- 19" (18.0" vis) M991 Monitor
- 32MB NVIDIA™ TNT2 M64 4X AGP Graphics
- 48X Max CD-ROM Drive
- SB Live! Value Digital
- harman/kardon® Speakers
- 56K Capable[6] PCI Telephony Modem for Windows®
- Integrated 3Com® 10/100 Ethernet Controller
- MS® Works Suite 2001 ■ MS® Windows® Me
- 3-Yr Limited Warranty[2] ■ 1-Yr At-Home Service[4]
- 1 Year of DellNet™ by MSN® Internet Access[10] Included

$1699 or as low as **$51** per mo. 45 mos.[12]

No payments for 90 days. E-VALUE Code: 89900-500216

DELL™ DIMENSION™ 8100 Series

Cutting-Edge Performance

- Intel® Pentium® 4 Processor at 1.4GHz
- 128MB SDRAM at 133MHz
- 60GB[5] Ultra ATA/100 Hard Drive (7200 RPM)
- 19" (18.0" vis, .26dp) M991 Monitor
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- 12X Max DVD-ROM Drive
- SB Live! Value Digital
- Altec Lansing® ACS-340™ Speakers with Subwoofer
- U.S. Robotics® 56K Capable[6] PCI Telephony Modem
- MS® Works Suite 2001 ■ MS® Windows® Me
- 3-Yr Limited Warranty[2] ■ 1-Yr At-Home Service[4]
- 1 Year of DellNet™ by MSN® Internet Access[10] Included

$2199 or as low as **$66** per mo. 45 mos.[12]

No payments for 90 days. E-VALUE Code: 89900-500221

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- Epson® Stylus 777 Color Printer, add $99
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- HP® ScanJet® 4300Cse, add $99 after $50 HP® Mail-in Rebate[38] (Reg. $149)

Power Protection:

- APC Pro8T2 SurgeArrest, add $39

Software:

- Extreme Game Pack (Dimension™ only)[16], add $99
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- L Series Premier 3-Yr At-Home Service[4], add $119

Inspiron™ Notebook Service Upgrades:

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- Inspiron™ 3800 and 4000 3-Yr Next-Business-Day On-site Service[4], 3-Yr Limited Warranty[2], add $219

intel inside

pentium® III

Includes Windows Millennium Edition — the home version of the world's favorite software.

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